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The Institute of Vitreous Enamellers
The National Ironfounding Employers' Federation
The Welsh Engineers' and Founders' Association
and
The Foundry Trades' Equipment and Supplies Association

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Contents

	PAGE
British Industries House	19
Dr. J. W. Mellor, F.R.S.	20
Book Review	20
Latest Developments in Power Transmission	20
Oven-Drying of Cores and Moulds	21
Exchange Restrictions in Germany	23
Recent Developments in British Synthetic Moulding Sand Practice	24
A Report of the Work of the Cast Iron Sub-Committee of the Technical Committee	27
French Foundry Association	30
A Discussion on Steel Castings	31
Catalogue Received	31
Institute of Metals	32
Thermal and Electrical Conductivity of Metals and Alloys	32
Setback in Spelter	32
This Week's News in Brief	33
Trade Talk	33
Contracts Open	33
Personal	33
Obituary	33
Raw Material Markets	34
Iron and Steel Production	34

British Industries House

Many of our readers have seen the impressive building in London near the Marble Arch, originally erected as a store. Under the name of British Industries House it has been transformed into an Empire buying centre, that is, a central market to which the world's buyers can come and see the goods they wish to buy displayed by the makers. It is really a permanent exhibition, and is primarily intended for manufactured goods and not for raw materials, which have their recognised exchanges. It is a grouped collection of show rooms, intended exclusively for British goods, either from the home country or from the Dominions and Colonies. It is not intended that the House should be open to the public, but only to buyers and sellers, and six floors are available for use. From the list of industries represented we see that the heavy industries, hardware and ironmongery, metal wares, motor accessories and scientific instruments, will be included, and all these, to a greater or lesser degree, interest the founder. Much will depend on competent management, for even very attractive ideas have failed during the past ten years to establish themselves. The present venture has the support and financial backing of some of the large insurance companies, and it will be possible to exhibit there either with or without a permanent staff, in the former case the House staff acting for the exhibitor.

An important feature is the establishment of a club, or rather two clubs, one for buyers and the other for makers, where the amenities of a club, a restaurant and a business office will be available.

A preliminary pamphlet indicates that the minimum cost of a show case may be taken at £1 per week, and of a show room £4 a week, the rental figure including rates and taxes, heat, light, cleaning and other services. Altogether, this scheme is a most ambitious experiment, and doubtless many prospective small exhibitors will ask themselves whether a show room could be used as an alternative to an office and show room elsewhere in the city. If so, participation may be very attractive financially. The scheme incidentally means that the business end of the city has spread westward as far as Hyde Park.

We, however, are not particularly impressed with this organisation, as it tends to create intensive competition at the very source of a business inquiry, or at the best makes the buyer suspicious of the existence of a price-fixing ring. We well remember, when we were interested in the electric-furnace business, how essential it was to know which foreign buyers were being shown the British plants of our competitors, and the interest displayed by other makers in the people sufficiently enthusiastic to visit Great Britain to inspect our installations. On many occasions the discovery of a buyer means much hard work and disagreeable travelling, but when one has found a really interested buyer, it is not good business for the whole of the home industry—maybe a matter of four or 30 firms who have not had the expense of travelling or entertaining—to be made cognisant of its existence. Obviously, they can quote a more favourable price, having had no preliminary expenses. It creates conditions comparable to flaunting one's best customer at the annual dinner of the appropriate trade or technical organisation.

Business conditions are much too complex to present a really good customer to any central buying establishment, and we have been impressed with the lack of imagination displayed by such organisations as British Industry House and Government departments in dealing with the overseas buyer. The very creation of such bodies implies that the foreign buyer is likely to have submitted to him the very lowest quotation of which Britain is capable of giving, which, in our submission, is not good business. Above all, the firm which has had the initiative to get the buyer to visit these shores is probably saddled with a fair amount of initial expense. Such institutions as the British Industries House may serve quite well for buying such articles as are standardised as to price and quality, but not those into which any degree of specialisation has entered.

In general, we are not very appreciative of co-operative efforts destined to place the foreign buyer in contact with the maximum number of British firms capable of manufacturing his particular requirements. Logically examined, the case of co-operative sales endeavours is unworthy of consideration until the home industry has pooled its resources into one all-embracing combine, and when such conditions have been created there is but little reason for the constituent companies to undertake individual representation.

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XUM

Dr. J. W. Mellor, F.R.S.

Dr. J. W. Mellor, the President of the Institute of Vitreous Enamellers, was born in Yorkshire, but his youth was spent in New Zealand. He completed his academic training there and at Manchester University, where he obtained the degree of Doctor of Science for his work on the union of hydrogen and chlorine.

On leaving the University, Dr. Mellor was appointed Science Master at the High School, Newcastle-under-Lyme. Here he soon became interested as a chemist in the intricate problems associated with the nearby pottery industry, and, after about a year he resigned his post at the High School and was appointed County Lecturer in Pottery at Tunstall, Stoke-on-Trent, in January, 1905. The great development in the teaching of clay technology since that time has been entirely due to Dr. Mellor's efforts, and when the North Staffordshire Technical College was opened in 1914, he was appointed Principal of the Pottery Department, a post from which he is now about to retire.

At about the time of his Tunstall appointment, Dr. Mellor threw in his lot with the small band of enthusiasts in the (then) North Staffordshire Ceramic Society. In September of the same year (1905) he was appointed Hon. Secretary of the Society, a position which he has held ever since. In ceramic circles it is universally recognised that the rise of the Ceramic Society to its present pre-eminent position has been due almost entirely to his exceptional ability, untiring energy and expert leadership.

Dr. Mellor early saw the need of co-operative research in the clay industries. In 1910 he commenced work for the gas industry under the ægis of the Institution of Gas Engineers. Largely as the result of his early efforts for the gas industry, the British Refractories Research Association, with Dr. Mellor as the first Director of Research, was founded in 1919. More than 190 Papers have now been published in the Bulletins of this Association, and it is acknowledged on all sides that the result of its activities has been a great increase in the efficiency of both the manufacture and the use of refractories.

Dr. Mellor is the author of a number of books on physical chemistry, including, among others, "Modern Inorganic Chemistry," "Chemical Statics and Dynamics," and "Higher Mathematics for Students of Chemistry and Physics." For many years his books have been used as textbooks the world over, particularly his "Modern Inorganic Chemistry." He has now finished the manuscript of his well-known "Comprehensive Treatise on Inorganic and Theoretical Chemistry," a monumental work of 15 or 16 volumes, unrivalled in any language, the importance of which to chemists cannot possibly be overestimated. Thirteen of these volumes have already appeared.

Dr. Mellor's Papers on ceramic subjects have been published mainly in the "Transactions of the Ceramic Society." They are, of course, far too numerous to mention here in detail, but reference may be made to his early work with his friend, Mr. Bernard Moore, the distinguished potter, on such subjects as "The Adsorption and Dissolution of Gases by Silicates—'Spit-out'"; "Flint and Quartz"; "Discoloration in Pottery and Bricks," etc.

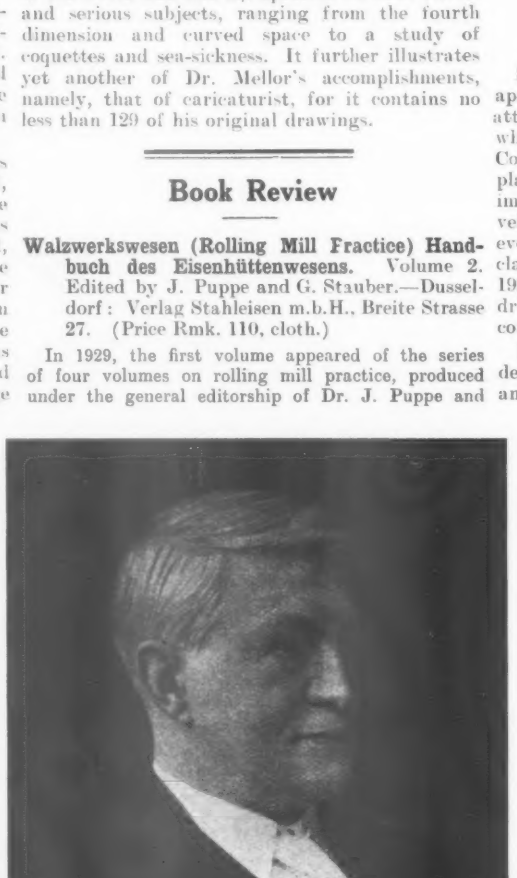
In 1927 Dr. Mellor had the well-merited distinction of being elected a Fellow of the Royal Society.

Dr. Mellor is first and foremost a scientist, with, however, a rare appreciation of literature and the lighter side of life. This latter trait is well illustrated in a book just published for him by the Ceramic Society, entitled: "Uncle Joe's Nonsense," and described as "A Medley of Fun and Philosophy for Young and Old Children." This book contains an account of some of his rather extraordinary adventures in various parts of the world and also his opinions on both trivial and serious subjects, ranging from the fourth dimension and curved space to a study of coquettes and sea-sickness. It further illustrates yet another of Dr. Mellor's accomplishments, namely, that of caricaturist, for it contains no less than 129 of his original drawings.

Book Review

Walzwerkswesen (Rolling Mill Practice) Handbuch des Eisenhüttenwesens. Volume 2. Edited by J. Puppe and G. Stauber.—Dusseldorf: Verlag Stahleisen m.b.H., Breite Strasse 27. (Price Rmk. 110, cloth.)

In 1929, the first volume appeared of the series of four volumes on rolling mill practice, produced under the general editorship of Dr. J. Puppe and G. Stauber and sponsored by the Verein deutscher Eisenhüttenleute.



DR. J. W. MELLOR, F.R.S.

The political and economic uncertainties since that time have caused a long delay in the issue of the second volume which has now appeared. This monumental volume deals comprehensively and exhaustively with the more practical side of rolling mill practice and describes the actual construction of the various plants designed for rolling heavy and light semis, shapes, bars and joists, hoops, wire rods, wire, etc. The different mills are dealt with in separate sections, each by a recognised specialist, according to the similarity or differences in the handling of the raw materials. It was originally intended to deal with these different mills in separate volumes, but the plan was abandoned in order to arrive at a comprehensive review of rolling mill plant in one volume, facilitating comparisons and a more systematic study of individual features. In each section, the development and present state of perfection of the various plant and processes are described for each specific rolling operation with special reference to constructional and operating details. The work is profusely illustrated with 223 diagrams and photographs, and is supplemented by a list of references to the principal literature at the end of each section. There are over 500 quarto pages. It is to be hoped that the remaining two volumes of this historic and invaluable work will appear in a reasonably short time.

Latest Developments in Power Transmission

A NOTABLE NEW FLUID COUPLING

In the whole field of power transmission, quite apart from motor vehicles, considerable interest attaches to the new Vulcan-Sinclair "Fluidrive," which is fitted on the 11-h.p. car of Singer & Company, Limited, of Coventry, just recently placed on the market and claimed to be a great improvement on the "fluid flywheel" for motor vehicles. This latter dates from 1930, and was evolved in connection with the "Vulcan-Sinclair" infinitely variable speed gear, invented in 1926, and now largely used for general industrial driving fans and centrifugal pumps direct-coupled to d.c. electric motors.

Essentially, the "Fluidrive" is a special design of hydraulic coupling for motor vehicles, and traction generally, including Diesel locomotives and rail cars, as well as mechanical excavators and portable Diesel-engine compressors

The fluid flywheel consists of a driving and a driven unit with vanes, not touching one another, operating in oil, the latter always remaining the same in amount. In general, the valuable properties of the drive are due to the fact that the power transmission through the oil increases very rapidly as the engine speed rises, that is, according to the cube of the speed. Thus, if a petrol engine runs at 300 revs. per min., as when idling, the power transmitted is not sufficient to drive the car. At a high speed, however, say, 3,600 revs. per min., twelve times the idling speed, the power transmission is 1,728 times as great (12 cubed), being practically a positive drive.

A fluid flywheel, however, has to be in practice a compromise between two opposing tendencies, high power slip when the engine is idling, to avoid the car "creeping," and low power slip, that is, high-power transmission at ordinary running speed. The "Fluidrive" has been designed on most ingenious lines to overcome these difficulties. Essentially, the new design is a fluid flywheel with the addition of an oil reservoir chamber at the back of the runner or driven unit. When the latter is stationary, with the engine idling, a portion of the oil passes by transfer ports into the reservoir so as to reduce the amount of oil in the coupling, and therefore the drag or creeping tendency of the car. When the engine accelerates and the speed of the runner increases, the oil in the reservoir is passed back to the coupling by centrifugal force, resulting in minimum slip, that is, high transmission efficiency. By varying the amount of oil in this manner automatically, the net result is a great improvement, especially in acceleration and petrol consumption, as compared with the fluid flywheel.

In this connection it may be stated that the new 11-h.p. "Singer," which costs £240 at the works (Coventry) as a four-seater four-door saloon, is also provided with another striking mechanical invention, the "Gordon-Armstrong" independent front-wheel suspension, in which the front-hub swivels are carried on pairs of parallel-motion arms of extremely rigid construction instead of the usual axle beams. In turn the parallel-motion arms are mounted on large-diameter transverse-trunnion shafts running in totally-enclosed bearings on the cross members of the chassis frame, and as a result both front wheels are independent of one another, and can pass over rough roads without giving any "kick" to the steering connection.

Further, in connection with the power transmission, there is fitted a four-speed helical-gear "Perm-mesh" pre-selective clutchless-gear change, and undoubtedly to-day the fluid type of transmission is one of the most important.

Oven-Drying of Cores and Moulds*

By E. G. Fiegehen, M.I.Mech.E.

Cores and moulds, as moulded ready for baking, contain sand, water and binders. Of these, the water is essential for mixing with the bonding material, such as clay, corn binders, starch, etc., into a plastic condition, so that, when milled with the proper amount of sand, a mixture is produced that is sufficiently plastic to be used for moulding and sufficiently strong, before baking (green bond), to retain its shape and to withstand handling on its way to the oven. The process of blending sand with binders and water is called "tempering" the sand, and the proper percentage of components and intimate mixing, in an efficient mill, is essential to success.

The object sought in milling and tempering sand is to cover each individual grain of sand with a thin coating of the binder. The binders have a tendency, in baking, to concentrate at the points of contact of adjacent sand grains, cementing these together and leaving air spaces between the grains, giving the desired porosity to the finished core to permit of the escape of steam and gases formed during the pouring of the mould.

If too much binder be used, or a binder unsuited to the purpose, it will wholly or partially fill up these necessary voids between the grains, and thus reduce the porosity of the core; if the sand be insufficiently milled the distribution of the binder will not be uniform and some portions will have low porosity, due to concentration of binder, whilst other portions will be insufficiently bonded; in any case defective castings will be produced.

Water as Aid to Baking

The tempering water also serves a further useful function as a conductor of heat to the interior of a core or mould, in the baking process, for when heat is applied to the outside of the core by the hot gases in the oven, it passes through the water in the core twice as easily as it does through the sand grains owing to its superior heat-conductivity. In G.G.S. units the average conductivity of still water is 0.0014 whilst the conductivity of sand is 0.0006, giving a ratio of conductivity in favour of water of 2.33 to 1.

The presence of the binder will probably modify the conductivity of the sand but, to illustrate this point, it may be said that the conductivity of water in a core is at least twice that of the sand. The presence of core-rods or core-arbors in a sand core provides an excellent medium for the rapid transmission of heat into the interior, for the conductivity of steel is very much greater than water. It is therefore desirable to retain the water in the core during the preliminary stages of drying so that the temperature at the centre of the core may rise to the boiling point of water.

Types of Binders Used

The binders used are gummy or adhesive substances such as clay, a mixture of corn-starch, flour, molasses, etc., or various core-oils, depending upon the application of the core. The binders are intended to cement the grains of sand together at their points of contact; baking greatly increases this cementing effect and produces strong cores that may be easily handled and fitted in place and which will resist the stresses imposed upon them in casting as well as the scour of the molten metal, whilst being of such a nature that, after casting, they may be broken up and readily removed in the cleaning operation, leaving a smooth surface on the casting.

It will be obvious that upon the proper selection of sand and binders for cores and moulds much of the success of the foundry operations will depend. Pitch has been used as a binder, but it does not give a "green bond," neither does it mix with water, and consequently it does not become a real binder until melted by the heat of the oven.

How Linseed Oil Acts

Raw linseed oil is an excellent binder and is extensively used. If linseed oil be kept in a closed bottle it will not dry up or "set," but if it is spread out, thinly, and exposed to the air, particularly hot air, it will dry up slowly by oxidation, whilst if hot air is blown upon it, it will dry up more rapidly.

According to the American Foundrymen's Association—oxidation of linseed oil is slow up to 350 deg. Fah. (176 deg. C.) but very much faster from 350 to 450 deg. Fah. (176 to 232 deg. C.). At 500 deg. Fah. (260 deg. C.) the qualities of the oil are destroyed. For oil cores (baking temperature 350 to 450 deg. Fah. (176 to 232 deg. C.) it has been found that a minimum of 1,000 cub. in. of air is necessary to oxidise the oil and produce maximum strength in cores weighing 1 lb. and containing 2 per cent. by volume of linseed oil. A baking time of 90 min., at 425 deg. Fah. (218 deg. C.), produces maximum strength of core 1 in. thick.

Hot air is used for drying moulds and cores, since it has a great capacity for absorbing water; at atmospheric pressure and 200 deg. Fah. (93 deg. C.) 1 lb. of bone-dry air will absorb about 2.3 lbs. of water vapour before reaching its saturation point. The temperature of the air must be regulated to prevent over-heating and the destruction of the binders used and no direct flame or intense radiant heat should come in contact with the cores in the oven. When the cores have been heated by the hot air, to the boiling point of water of atmospheric pressure (212 deg. Fah. or 100 deg. C.), the moisture in the cores is converted into steam which escapes through the pores of the sand core to the surface and out of the oven through the vents.

Hot air is especially useful in the drying of cores since, owing to its capacity for absorbing water, a current of hot air acts like a sponge passing over the wet surface of the mould or core, carrying the water away with it, to be followed by the passage of fresh dry air to continue the process. Thick cores take longer to dry than thin ones, for the reason that the heat has further to penetrate to the centre and the evaporated water takes longer to reach the surface; an increased temperature cannot be used to hurry the operation, otherwise the binders will be burnt and the core will be useless.

Mould and Core-Drying Compared

Nearly the whole surface of a sand core, if properly loaded in the oven so as to ensure efficient circulation, is exposed to the oven gases, whereas a mould being partly enclosed in a flask generally exposes, freely, only one face. Consequently, it takes appreciably longer to dry a mould than a core of the same weight and thickness of sand, for again the heating cannot be hurried for fear of damaging the mould.

Until the binders have "set," cementing the grains of sand together firmly, a core has very little mechanical strength, and will readily crack on the sudden application of heat, owing to unequal expansion of the hot surface and cold interior or, possibly, owing to the expansion of water or steam trapped between the sand grains of a dense core, forcing them apart; both these evils may be caused by too rapid heating.

To dry cores and moulds successfully, without surface cracking, a moderate oven temperature, determined by experience and carefully controlled, is essential, and it is now recognised that three distinctive stages of drying have to be arranged, as set out below.

Period I.—Constant Rate Drying

During this first period of drying, the surface of the core is wet and the effect of heating from the outside is to cause some of the water in the interior of the core to travel to the surface, where the surface tension has been lowered by heating. The heat of the oven gases causes this surface water to evaporate, but so long as any water remains on the surface, the temperature of the wet surface cannot rise above the boiling point of water (212 deg. Fah.—100 deg. C.), however hot the oven gases may be.

This may be difficult to realise, but it is most important and can be proved by an experiment of placing a paper bag containing water over a gas flame. So long as any water remains in the bag the paper will not be burnt, but when all the water has been evaporated, the bag burns immediately. In the same way the wet surface of a core acts as a heat shield to it, preventing the temperature rising above 212 deg. Fah. (100 deg. C.), at which temperature cracking is not to be feared. At this stage it is desired to get heat into the body of the core but to make no attempt to dry it.

The water in the core is a much better conductor of heat than either sand or air, and consequently the proper method is to make use of this property of water by retaining it in the core until it is heated throughout. To this end, it is best not to allow the moisture-laden air in the oven to escape, at this stage, but retain it and circulate it, from top to bottom of the oven, to ensure a uniform temperature of all cores in the oven and to preserve a damp atmosphere, which will retard evaporation of the surface-water on the cores.

If there were no circulation, the hot air would rise and remain at the top of the oven, as it does in a heated room, leaving the cores on the lower shelves comparatively cold, and if the moist air in the oven be allowed to escape, the water-shield on the surface of the cores would disappear. When the cores are heated evenly to the centre, which can be ascertained by a trial of dummy cores, there is no further need for the internal water in the cores and the process is ready for the second stage.

Period II.—Saturated Surface Drying

In the first period no attempt was made to dry the cores, but suitable conditions were arranged for heating them, throughout, rapidly and safely by the aid of their contained water and whilst they were shielded from overheating by their wet surfaces. In this second period the real drying is to be effected. The flues are opened now to allow the moisture-laden air to escape, and the circulating fan draws in fresh air, to be heated and to absorb moisture from the surface of the cores and pass out through the pipe with this moisture.

The evaporation of water, in contact with moving air at a given temperature, varies almost directly as the velocity of the air, and it is found that an air-current striking a surface at right angles is about twice as efficient, in evaporating water, as a current passing longitudinally over the surface. The protecting film of moisture will gradually disappear and the temperature of the oven must consequently be reduced, during this period, for fear of burning the binders and causing cracks in the now unprotected cores.

It is found that the circulation of a large volume of air at a moderate temperature is more effective and safer than the use of a small quantity of very hot air. As the moisture is evaporated from the surface of the cores, fresh moisture from their interior travels to the surface, is evaporated, and passes out of the oven.

* A Paper read before the Annual Conference of the Institute of British Foundrymen held at Manchester, June 5 to June 8.

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Eventually the surface dries up and then, the water-film insulation effect being removed, the whole core rises in temperature nearly to that of the hot gases. This rise in temperature, together with the presence of fresh hot air—containing oxygen—which can now penetrate the pores of the dry core, causes the binder to dry and oxidise and cement the grains of sand firmly together, giving the necessary dry strength to the core.

There will still remain a small proportion of moisture in the interior of the core, and to evaporate and remove this there is a third stage.

Period III.—Sub-surface Drying

The whole body of the cores are now well above the temperature corresponding to the boiling-point of water, so that, in this period, the heat in the cores themselves is sufficient to evaporate the small amount of moisture remaining in the interior, which passes out of the core through the pores in the sand. Consequently only sufficient air circulation is now required to carry off this reduced flow of steam, and only a small amount of heat need be supplied, by the furnace, to maintain the temperature of the oven; the flues must still be open sufficiently to allow the steam to escape. Recirculation may be stopped in this period, for all the cores are now uniformly heated, and the binders are "set" by the oxygen in the air supplied in the previous period.

Summary of Operations

Period I.—Rapid heating—Vigorous recirculation with fan—Air-inlet flues closed—Continued until the interior of all cores reaches approximately 212 deg. Fah. (100 deg. C.).

Period II.—Reduced heating—Moderate recirculation — Air-inlet flues open — Continued until the surface of cores is thoroughly dry and binders are set.

Period III.—Minimum heating—No recirculation—Air-inlet flues partly open.

Core Ovens

The earlier examples of core ovens were constructed of building-brick, and generally coal-fired, with primitive flue arrangements and control, and no provision for recirculation to speed the drying and equalise the temperature in all parts of the oven. Comparatively high temperatures were used, and the top of the oven was much hotter than the bottom. The loss from cracking and burning was naturally high, and to complete the baking the lower cores had to be transferred to the upper shelves.

In all modern (Canadian) steel foundries newer types of ovens, embodying the principles outlined above, are being installed with most satisfactory results. The shell of such ovens generally consists of steel plating, in panel construction, between which insulating mattresses of rock-wool, or insulating bricks, are inserted to minimise loss of heat from the external surfaces. The economical thickness of insulation can be determined by comparing its cost, spread over its useful life, with the fuel saving effected by its use over the same period.

In average practice, a thickness of 4 in. of insulation is found satisfactory. Such ovens are most frequently fired by oil or gas as being more easily controlled and involving less labour than coal firing; the combustion chambers of fire-brick are preferably located below the oven, thus saving valuable floor space.

The flues from the combustion chamber to the interior of the oven are located and dimensioned so as to ensure a uniform distribution of the combustion gases. To each oven an exhausting fan is fitted, driven by a motor and arranged to draw, through ducts, the hot air and gases from the top of the oven and discharge them at the bottom of the oven, equalising the temperature in the chamber effectively. By this means a circulation of from ten to twenty times the net volume of the oven is secured according to requirements. Owing to the high temperature of the gases passing through the fan, water-cooled bearings are necessary.

As an alternative to a fan, a series of air-blowers of the ejector type have been tried, and have given satisfactory results when operated by compressed air from the shop mains. As against the somewhat greater cost of power with this method may be set the low capital cost and reduced maintenance. A simple type of single-cone blower used for this purpose was found, on test, to induce about 10 cub. ft of oven gases for each cubic foot of free air, compressed to 60 lbs. per sq. in. Better results may be expected from a multi-cone design of blower.

Loading Considerations

Most of the core and mould-ovens installed in Canadian steel foundries are of the car-type, the core plates being placed on core racks, which, in turn, are loaded on wheeled cars and run into the oven. By the use of two cars per oven, one can be loaded whilst the other is in the oven, in the case of large-mould ovens the car-type is extremely desirable to permit loading by a crane, although, in some instances, a removable oven-roof permits this to be done and saves the space occupied by car tracks. The car-type design has the disadvantage that the car itself occupies an appreciable volume of oven space and absorbs a quantity of heat, unprofitably. Sometimes core racks are loaded into the oven by electric—or petrol—lift trucks, and then the utilisation of oven space is much better, and crane-handling of racks is eliminated.

Core Plates

Modern core plates are of welded steel, ribbed and perforated construction, and are equally as strong as the old-fashioned thick cast-iron plates. but weigh much less and consequently absorb less heat. For certain cores, aluminium holders, carriers or "driers" are provided, in which the core is moulded and in which they remain whilst baking; this makes it unnecessary to consider the "green strength" of such cores, the binders in which can be chosen with more particular regard to final strength and porosity.

Substantial savings may be effected by a careful consideration of the handling and loading of cores; with regard to the latter it is quite obvious that the arrangement of the oven-car, core-plates and cores in an oven has an important effect upon the movement of the gases therein, all being obstructions in the flow of the circulating gases.

Control Experiments

A survey of temperatures, at various points in actual operation, may indicate obstructed circulation and suggest some re-location of duct openings or rearrangement of the cores on the trays. Useful information regarding the flow of the gases may be obtained by illuminating the interior of the oven with electric lamps arranged to project their light through openings and then observing, through other openings, the movement of smoke, introduced into the combustion chamber for the purpose.

In this matter of uniformity of temperature, it is important that oven doors should be close-fitting, for, owing to their large perimeter, a small opening will admit a large quantity of cold air.

Doors should be fairly flexible, laterally, to reduce the tendency to warp, due to the difference in internal and external temperature; the forces set up by unequal expansion are large, but they cause little distortion of a door deliberately made weak in the bending plane.

The provision of numerous hinges, properly aligned, and well-designed latching gear which will force the flexible door to its seat, is essential, and the sealing of the bottom of the doors should not be overlooked. It is useless to try to control the flow of gases and temperature-equalisation in the oven if the leakage past the door varies in quantity and location with each batch of cores baked.

Temperature Control

All core ovens should be provided with indicating and recording thermometers; the records properly numbered and dated, are most useful in indicating the efficiency of the operator and in tracing subsequent trouble to its source. It is desirable to have several thermometers, located at various points in the oven, even if, as usual, one only, at a selected spot, is relied upon for normal records and perhaps control. The comparison of the temperatures at various points will indicate the efficiency of the circulation in the oven. Where automatic temperature control is fitted to an oven, means must be provided to give the temperature appropriate to each period of drying, as previously indicated above.

Continuous Core Ovens

Continuous core ovens have been found very satisfactory and uniform in performance for the drying of large quantities of small- and medium-size cores, all requiring the same period of baking. The cores are placed upon trays suspended from a slowly-moving chain conveyor, arranged horizontally or vertically and are baked whilst passing through a heated chamber to the unloading station.

The time of baking is regulated by the speed of the chain, which is adjustable; re-circulation and the necessary variation in temperature and venting, as required, can be arranged and the addition of a good conveyor service, for loading and unloading, makes a very efficient installation, and, in the case of the vertical type, very little floor space is occupied.

Heat Supply

The amount of heat to be supplied to a given oven will depend upon the weight of the cores, core plates, car, etc., that have to be heated, the moisture content of the cores, binders used, and a number of other factors. In providing heating apparatus on the installation of the oven, a loading will have to be assumed that will call for the maximum demand for heat and air circulation. The variables entering into this problem are numerous, and it is hardly to be expected that the result of calculation will be exact, but if care is taken to obtain accurate information regarding the loading of the oven and judgment is exercised in the selection of coefficients and the application of a factor to cover the effect of leakage, variable room temperature and air humidity, the result should be reasonably close to the actual performance.

In calculating the heat required to bake a given charge of cores or moulds, we may summarise the following major items:—

Assume that the cores, as moulded contain by weight:—

	Per Cent.
Sand and binder	87
Water	8
Core rods	5

Oven Temperatures.

Period I.—450 deg. Fah. (232 deg. C.).
Period II.—300 deg. Fah. (149 deg. C.).
Period III.—450 deg. Fah. (232 deg. C.).
Room temperature, 60 deg. Fah. (15 deg. C.).

Item 1.—Heat required for sand.

Temperature rise, 450-60 = 390 deg. Fah. (217 deg. C.).

Approximate weight of dry sand, as rammed, 125 lbs. per cub. ft.

Approximate specific heat, 0.195.

B.T.U. = Weight of cores (lbs.) × 0.87 × 390 deg. × 0.195.

Item 2.—Heat required to evaporate moisture in sand.

B.T.U. = Weight of cores × 0.08 × 1122.

Item 3.—Heat required for core rods.

Temperature rise 450 − 60 = 390 deg. Fah.

Specific heat of steel = 0.165.

B.T.U. = Weight of cores × 0.05 × 390 deg. × 0.165.

Item 4.—Heat required for core plates and racks, oven truck and rails, internal ducts, etc.

Temperature rise 450 − 60 = 390.

B.T.U. = Total weight of steel and iron × 390 deg. × 0.165.

Item 5.—Heat required for oven structure (steel plating with enclosed insulation). Mean temperature at equilibrium will depend upon construction and can be found from tables of external temperature and surface loss.

B.T.U. = [Wt. of steelwork × (mean temperature − 60) × 0.165] + [Wt. of insulation × (mean temperature − 60) × 0.20].

Item 6.—Heat required for brickwork of combustion chamber and ducts to oven.

This is a really difficult item, owing to the great weight and high capacity for heat of the brickwork.

This is further complicated by a variation of both its specific heat and conductivity with temperature.

Owing to absorbtion of heat, it may be 4 or 5 hrs. before the heat from the combustion chamber penetrates to the outside of its firebrick wall.

The consequence is that there is a greater demand for heat in the first heating of the oven than for succeeding heatings. As against this, there is less loss from the external surfaces of the brickwork on the first heating than in subsequent heatings.

However, some approximation must be made, and it will be assumed that the mean temperature of the brickwork, during the first heating, is ½ (450 − 60) = 130, giving a temperature rise of 130 − 60 = 70 deg. Fah. Then B.T.U. (approx.) = weight of brickwork (lbs.) × 70 deg. Fah. × 0.20 (average). For those desiring a closer approximation of the heat absorbed by a brick structure, there exists a fairly simple graphical method of plotting time-temperature curves and hence the heat demand on a time basis.*

The relative magnitude of the above rough approximation to the total heat demand of the oven will indicate whether this refinement of calculation is justified, bearing in mind that, for its first oven heats, considerable latitude, in oil supply and time of baking, can generally be obtained.

Item 7.—Heat required to replace radiation and convection losses from external surfaces of oven and ducts.

The external loss coefficient in B.T.U. per sq. ft. per hr. can be found approximately from tables when the wall construction and the internal and external temperatures are known.

The heat loss from horizontal surfaces, such as the roof, facing upwards, is generally taken as 10 per cent. greater than for the vertical faces. If a current of air be blowing on the surfaces, the loss will be increased.

Item 8.—Heat to replace losses from exterior of combustion chamber walls. As noted above, this loss for the first 4 or 5 hrs. will be nil. After that time, an allowance of one-half the loss per sq. ft. per hr. of the oven walls will be ample.

Item 9.—Heat to raise the temperature of the circulating air. Temperature rise, 300 to 60 = 240 deg. Fah. Changes of oven volume per hr. = 20. Specific heat of air, at constant pressure = 0.24 (approximately).

B.T.U. = 20 × net volume of oven (cub. ft.) × hours recirculation in operation × 240 deg. × 0.24 / 19.6 (cub. ft. per lb. at 300 deg. Fah.).

Item 10.—Heat required for heating the air for combustion at the burners (which leaves the oven at approximately 450 deg. Fah.).

This is a comparatively small item, since only about 22 lbs. of air are required for the combustion of 1 lb. of fuel oil.

In the case of oil-fired oven, where the products of combustion pass direct into the oven, give up a large proportion of their heat there and pass out at the vents at, say, 450 deg. Fah., the "stack loss" is much smaller than in the case of, say, annealing furnaces where, owing to the conditions, the gases have to leave the furnace chamber perhaps at 1,850 deg. Fah. (1,010 deg. C.); consequently, the efficiency of combustion in oil-fired ovens is higher than in annealers, the oven acting, in fact, as a heat recuperator for the combustion gases.

Referring again to Item 9, it may be remarked that the heat required for raising the temperature of the circulating air in Period II, together with the heating of a certain amount of cold air leaking into the oven in Period I, may often equal the heat actually required for heating the cores and driving off their moisture. It is important, therefore, to ascertain, by trial, what volume of circulation is actually needed for satisfactory results, in baking and hardening the cores that the oven is designed to handle.

Any excess of circulation would certainly do no harm, but it obviously represents a wasteful expenditure of heat and power to drive the fan. Only comparatively small cores need to be baked bone-dry throughout. In cores of appreciable thickness (say, over 2 in. thick), only 2 or 3 in. below the surface need be bone-dry, for the general run of work; at 6 in. deep there may be, perhaps, 1 per cent moisture and at 10 in. deep, say, 3 per cent. moisture without detriment.

Such cores, however, should be used shortly after leaving the oven, for, if they are stored there is the obvious risk of the contained moisture travelling outwards to the surface, by capillarity. Any cores kept in stock will be baked practically dry and must be stored in a dry, heated space, generally above the core ovens, to prevent absorbtion of moisture that is always present in the air.

Electric Core Ovens

When electricity can be obtained at a very low rate, core ovens may be heated by resistors placed, generally, on the sides of the oven itself. The heat from these resistors must, however, be transmitted to the cores by air circulated by a fan, since abundant air is required, any way, as an absorbent of moisture, and direct-radiant heating is inadmissible, owing to the toasting effect, which causes cracks and destruction of the binders.

The quality of the cores used is one of the major factors in the production of good castings, free from blow-holes, scabs and other defects, easy to clean, true to size and of a good finish. With high-class materials, good equipment, technique and supervision good cores are not difficult to produce.

The cost of cores, related to the total production cost per ton of finished castings, is not excessive. It is clear, then, that careful attention to all aspects of this problem, the installation of up-to-date ovens, attention to loading, testing, temperature control and handling will be well repaid in the reduction of rejected castings and the production of a better grade of product.

* W. Trinks—Industrial Furnaces. J. Wiley & Sons.

National Physical Laboratory

The General Board of the National Physical Laboratory held their annual inspection of the Laboratory last week, the guests being received by Sir Frederick Gowland Hopkins (President of the Royal Society, chairman of the Board), and Sir Joseph Petavel (director).

Exchange Restrictions in Germany

We have been asked by the Board of Trade to publish the following announcement, which has been issued to the Press.

"The attention of the German delegates at present in London has been drawn to the urgent importance of means being found for the prompt liquidation of outstanding trade debts.

"It is desired to ascertain for the information of H.M. Government in the first instance particulars of outstanding trade debts which have not been paid to firms in the United Kingdom on account of new exchange restrictions in Germany imposed as from March 1, 1934.

"Companies, firms and persons in the United Kingdom are therefore requested to supply, with the least possible delay, three copies of all invoices, payment of which by German importers became due after February 28, 1934, and before July 1, 1934, but was not remitted on account of exchange restrictions.

"Bad and doubtful debts which have not been paid owing to insolvency or financial difficulty of German debtors should be excluded, and invoices must be accompanied by a statement on the part of the creditor that non-payment of the debt has, to his belief, been caused solely by the exchange restrictions.

"On the face of each invoice supplied the following additional information should be given:—

"The precise date on which the amount was due for payment by the debtor (where bills of exchange were drawn, the due date of the acceptance).

"If the debtor has paid the equivalent in marks into blocked account the amount in marks should be given.

"If the goods in respect of which payment is claimed were (*a*) re-exports,* (*b*) transshipments under bond, or (*c*) goods shipped direct to Germany from a country other than the United Kingdom, this should be stated, together with the country of origin of the goods in question, if known.

"In the event of any debt which has been notified to the Board of Trade being subsequently paid, it is essential that the Board of Trade should at once be informed.

"The information given in regard to individual debts will be treated as strictly confidential.

"The total amount outstanding should be summarised in a covering letter which, together with the copies of invoices, should be addressed to:—

The Assistant Secretary,
Commercial Relations and Treaties Department,
Board of Trade,
Great George Street,
S.W.1."

* Re-exports.—Goods which are exported in the condition in which they were imported, or which have been merely sorted, repacked, or blended in the United Kingdom so as not to alter their character and are then exported are included in the Exports of Imported Merchandise. Goods which, after importation, have been subjected in the United Kingdom to an operation which has altered their composition, character, or, to an appreciable extent, their value, and are then exported, are included in the Exports of the Produce and Manufactures of the United Kingdom.

Growth of Cast Iron

To study the effect of silicon, phosphorus and manganese on the growth of cast iron, I. FECZCZENKO-CZOPIWSKI and S. NOWOSIELSKI prepared a series of samples of foundry iron, hematite, spiegeleisen and ferro-manganese, which were heated to 800 deg. in an electric muffle furnace for 100 hrs. with 15 intermediate coolings, during which the growth was measured. The results of this work are reported on in "Hutnik."

Recent Developments in British Synthetic Moulding Sand Practice

DISCUSSION

Importance of Roughened Grain Surfaces

Mr. John J. Sheehan's Paper sounded a new note in foundry-sand practice and received, what it richly deserved, an excellent discussion.

MR. F. HUDSON, who opened the discussion, said the Paper was most interesting, particularly considering the original line of thought adopted by Mr. Sheehan and the numerous debatable points. It was not surprising that the original natural moulding-sand mixture gave serious trouble, both in preparation and service, and he doubted if any equipment could be obtained to effect efficient mixing of a sand of this nature. Perhaps Mr. Sheehan would confirm the statistics given in regard to sand requirements and time for mixing each batch, as a mixing time of 5½ minutes would give the required output instead of the allowed time of 2½ minutes. Furthermore, he did not think the test results, giving a comparison between the modern raised-roller type of mill and its elder brother were fair, as here, again, the test mixtures were inclined to be exceptional for green-sand moulding, which he presumed was the practice employed.

Alkalies and Refractories

He was also particularly interested to note that Mr. Sheehan discontinued the use of red sand as part of his sand mixture, a point in keeping with his own experience, for the improvement of permeability, but inclined to be overstressed so far as refractoriness was concerned. Candidly, the question of alkalies lowering the refractoriness of a sand was of little consequence in the presence of coal dust or other carbonaceous matter, particularly when light to medium castings were being produced. He thought it would also be admitted that the refractoriness of sand was effected by two factors: (1) the temperature of the metal in the mould and (2) the pressure of the metal on the mould surface.

Temperature of Metal in Moulds

These factors did not entirely depend on temperature of pouring, but were largely affected by the type of casting being produced. For example, in the case of cast iron the following points might be of interest:—Using an initial casting temperature of 1,340 deg. C., it has been found by actual test that the temperature of the metal in the mould immediately after pouring is completed is seriously reduced. (See Table A.)

TABLE A.—*Initial pouring temperature* 1,340 *deg. C.*

Casting section with normal size of gates.	Temperature of metal in mould immediately after pouring in deg. C.	
	Green sand.	Dry sand.
¾ inch	1,100	1,100
1 ,,	1,140	1,150
2 ,,	1,160	1,160
3 ,,	1,180	1,200
4 ,,	1,190	1,210

For example, in the case of a casting, ¾-in. section, the temperature of the metal in the mould has been reduced from 1,340 deg. C. down to 1,100 deg. C. This point should be fully taken into account when considering the refractoriness of moulding sands, as even the least refractory sand would stand up to 1,100 deg. C. and only the pouring basin and runner would be subject to the action of the metal temperature as poured.

Grain Surface and Strength

The effect of grain surface on the strength of the sand was particularly interesting, and personally Mr. Hudson said he would like to compliment Mr. Sheehan on the promotion of this new line of thought, and the clear manner of its exposition. At the same time, however, he would not be so dogmatic as to say that moulds made from synthetic sands were incapable of being patched or "sleeked." The average moulder in this country had become accustomed to the use of heavily-bonded natural sands containing excess clay bond. Moulds made from such sands could be easily sleeked and patched because when the moulder applied water to the mould with his swab, there was sufficient clay present to absorb this water without becoming unduly sticky. In the case of moulds made from synthetic sand the use of the swab was fatal, as the swab carried more water than the clay present was capable of absorbing, and the result, in the Scottish vernacular, was a "clarty mess." For the repair of moulds made in synthetic sand a swab should not be used, and water should be added to the mould surface by means of a fine spray such as one used for spraying roses. To his mind the effect of moisture was intimately associated with grain surface conditions, as regards the question of surface tension, and in this present Paper this had not received the attention it merited. In fact, one could not very well consider one without the other, and their combined effect could quite readily reverse some of the statements made by Mr. Sheehan. For example, the effect of adding such materials as molasses and wood extract, etc., did not necessarily increase the surface tension between pattern and the bond, and he certainly could not agree that there was danger in their addition.

Mr. Hudson said he noted that fusion points were given for Bentonite and Colbond. Perhaps Mr. Sheehan would indicate if these could be classed as authentic? Would it not have been preferable to determine the fusion point of the final sand mixture made from these products?

Is Facing Sand Necessary?

Finally, he asked Mr. Sheehan why he used facing sand at all, as from the physical properties given for his synthetic backing sand this should be capable of producing satisfactory moulds alone. In his own practice he was getting satisfaction when using over 99 per cent. old sand, and the trouble was to keep down the green bond. The reason for this had been puzzling for some time, but after reading the excellent Paper he was of the opinion that the cause could be partially attributed to the roughening of the base sand grains through repeated use and the corresponding better adhesion between the sand grain and added bond. He closed with the suggestion that perhaps Mr. Sheehan would see his way to give a further Paper at some later date, when his researches were complete.

Grain Surface and Coal Dust

MR. BEN HIRD said the author had smoothed down another patch on the very rough road to a perfect moulding sand, and it was only by each smoothing down his little patch as well as possible that the industry would arrive at what it sought. He, like Mr. Hudson, had difficulty in understanding why Mr. Sheehan used facing sand at all, because he could use the backing sand quite satisfactorily for facing sand. Mr. Hird said his experience was similar to Mr. Hudson's, and the backing sand and facing sand on his mechanical plant was the same. Further—and this was the point of chief interest to him—he had found that the sand, without the addition of any red sand or bonding clay, only 2½ per cent. coal dust to each mix, gained in bond strength, and it was necessary to weaken it periodically. His own view was that surface tension was the crux of this rather peculiar gain in strength when there was no addition of new sand or clay, and he was particularly interested that Mr. Sheehan had arrived at that view. It was stated in the Paper that "There is some evidence that this ferruginous bond is burnt on to the sand grain. Ferric hydroxide mixed with similar sand grains is readily washed out, while ferric hydroxide precipitated on the sand grains and burnt on resists repeated washings. This coating gives a grip to the clay bond and assists it in making the sand that much stronger. But what is much more interesting and important, particularly in jobbing floor work, is that this coating grips the drier bond at the mould surface." That, continued Mr. Hird, was the point he had raised about coal dust. If one examined the black sand grains which was caused by coal additions one would find that the small specks of coal, after having been heated by the metal, became coke or a hard tarry substance, which adhered firmly to each sand grain, so that the grains became very rough. There were two deposits—a kind of sooty tar which affected the sand grain as though it were covered with fine emery, and in addition to that there were clinging to it, mostly on the grains which form the mould faces, the small specks of coal which had been burnt by the heat of the metal to a carbon or coke. These were almost like the small white limpets clinging to the rocks on the seashore, and they give a very rough surface to the sand grains. He suggested that if Mr. Sheehan would follow this line of thought, instead of roughening the grains with acid or striving to burn on the hybrids mentioned, he would find that the coal dust would give him just what he was looking for. Mr. Hird congratulated Mr. Sheehan on a most interesting Paper and hoped he would make further experiments with coal-dust additions to sands.

Facing Sands and Reclamation

MR. J. J. MCCLELLAND complimented the author particularly on having presented a Paper which could be followed clearly by the practical man, and for having tackled a subject which it was hoped would eliminate eventually very many of the difficulties with which the practical man had to contend. In asking the author to expand his remarks on one or two of the points raised, Mr. McClelland referred to the *résumé* which the author had given of his resulting sand practice, where it was suggested, in regard to the facing-sand preparation, that there should be used 14 parts of spent backing sand by volume, 4 parts of Leighton Buzzard sand by volume, ¾ part of Colbond and 1¼ parts of coal dust. One did not notice any suggestion in the Paper as to whether the spent sand was to receive any treatment, but he raised the question because he had found that after sand had been used for a considerable time, and sometimes a shorter time, it gathered a certain amount of silt, which reduced the permeability. Did the author intend to treat the spent sand in order to eliminate any silt that might have accumulated? It was also stated in the Paper that it was intended to substitute the new sand additions to the facing sand by spent core sand. Mr. McClelland asked if it were to be assumed that the spent core sand had contained an artificial or natural bond before use, because in practice it was found that after use the bond was not entirely eliminated, so that by using that sand again one obtained the value of any bond remaining in it.

Another statement in the Paper to which he referred was that no spent sand is now being dumped, and that the new sand additions were higher than the grey-iron system required. If we were to get all that we expected or hoped for from this new synthetic sand method, commented Mr. McClelland, why should we need new sand? New sand was generally introduced for the purpose of renewing lost bond, but if

the treatment referred to in the Paper was to be successful at all, one naturally presumed that it would eliminate the necessity for the introduction of new sand, except to the extent of the amount lost in the use of the sand.

American and British Practice

DR. J. G. A. SKERL (B.C.I.R.A.), in congratulating Mr. Sheehan on the value of his Paper, stated that it had interested him greatly, since he was at one time in very close contact with the foundry wherein the experiments had been carried out. The moulding mixture containing the mixture of red Bromsgrove sand and yellow Belgian sand, upon which Mr. Hudson had adversely commented, was the result of the attempt to meet a certain specification for a green-sand moulding mixture as used in at least one of the large American automobile foundries, the specification being based and checked on American foundry-sand control equipment. Mr. Sheehan's results confirmed his own experience that specifications for moulding-sand mixtures for strength and permeability would not be of much value unless we possessed a knowledge of the fundamental characteristics of the sands used. The important consideration with a moulding sand was the properties, not at atmospheric conditions, but at temperatures at which the metal which was cast into it was molten. Two sands possessing similar strength and permeability constants at ordinary temperatures would behave quite differently at a temperature of 1,000 deg. C. or less, due to those fundamental factors, some of which, like the oxide film, Mr. Sheehan had been investigating.

Ferruginous Bonds

The work done on the ferruginous and other bonds by Mr. Sheehan reminded him of the Paper presented by Mr. C. W. H. Holmes to the Iron and Steel Institute (Journ. Iron and Steel Inst., Vol. CVI, pp. 61-87, 1922), and that presented by the same author as the I.B.F. Exchange Paper to the International Foundrymen's Congress, Paris (F.T.J., Vol. 28, 1923, pp. 296-298, 308-311). These Papers had brought forward the idea of a "static" and a "mobile" bond in moulding sands, based on experimental evidence, which the present Paper confirmed.

It was interesting to note that in this country it was believed, following Prof. P. G. H. Boswell, F.R.S., whose valuable work had received recognition in Mr. Sheehan's Paper, and others, that iron oxide was beneficial in a moulding sand, especially for green-sand moulds. In America, on the other hand, the opposite view that it was detrimental, was more usually expressed. One could point out that over a period of years it had been shown that the increase in the iron-oxide content of the bonding material had definitely improved the practical results in the case of one commercial British semi-synthetic moulding sand.

Belgian Sand

Mr Sheehan had quoted some figures from Prof. P. G. H. Boswell's "Memoir on Refractory Sand" regarding Belgian yellow sand. The chemical and mechanical analyses of Prof. Boswell's and Mr. Sheehan's samples of Belgian yellow sand differed considerably and indicated variation as to source. A refractoriness test, by Dr. J. W. Mellor, F.R.S., of Stoke, of 1,480 deg. C. was given for the Belgian yellow sand, but from the facts, which showed that large steel castings are made in Belgian yellow sand in many foundries in this country, he would suggest that the figure is low. The evidence would seem to point to the fact that the Belgian yellow sand as tested by Mr. Sheehan is not representative of this sand as generally used in this country.

The question of the refractoriness of the bonding material in a moulding sand had been raised in the Paper and in the discussion. It was generally true of natural moulding sands that the bonding material was less refractory than the bulk of the sand itself, but properly distributed bonding material in a sand mixture, particularly under those conditions where as little as possible is required, as when efficient mixing and milling is carried out it was found that the influence was not very great. If a bonding material of even comparatively low refractoriness is properly distributed throughout a sand the resulting material is fairly highly refractory. By attention to such points as good distribution of the bonding material, some firms are able to make steel castings in the red Bunter sands which Mr. Sheehan finds not refractory enough for his cast-iron cylinder blocks, even though most foundries making these castings use such sand.

Iron-Oxide Content

Mr. Sheehan has stressed the iron-oxide content as of great importance and carried out many of his experiments to this end. Nevertheless, in his present sand practice he is using a bonding material containing only 3.08 per cent. of iron oxide, as against 10 per cent. in Belgian yellow sand clay-bonding material (Prof. Boswell's figures) and about 7 per cent. in the Bromsgrove bonding material. He (Dr. Skerl) suggested that a bond containing a higher iron content would offer certain advantages.

In a footnote to the screening figures on Erith silica and Leighton Buzzard sands, it is stated that I.M.M. screens were used to conform to the more general practice in this country. It should be stated that the Institute of Mining and Metallurgy have dropped their series of sieves in favour of the British Standard Specification sieves, which have similar apertures to the Tyler screens.

Finally, in thanking the author again for his Paper, Dr. Skerl expressed his pleasure in hearing a Paper in which fundamentals were dealt with, and that he would continue the experiments.

Permeability and Bond

MR. J. H. COOPER, who said the acquisition of the information contained in the Paper had entailed far more work than was realised, asked Mr. Sheehan what was the largest green-sand mould he had made in synthetic sand. He himself had seen castings weighing up to 4 tons made in Belgian green sand in this country; they were very well made, and had exceedingly good finish.

With regard to the reference made in the course of the discussion to the addition of new sand to add to bond, Mr. Cooper contended that in many cases new sand was added, not to increase the bond of the material, but to increase the permeability. It seemed that Mr. Sheehan agreed with that view, because in many cases he had used Leighton Buzzard sand to open the material. When sand was used in a mould under any conditions it was always split up by the heat of the metal in casting, and eventually became so fine that one could get almost any bond. But that was at the expense of permeability, and in all moulds, whether made with synthetic or other moulding sands, there must be permeability in addition to bond strength.

Grain Surface

MR. F. K. NEATH, discussing the function of iron oxide as a bond, said there was no doubt that the condition of the surface of the grains in synthetic sands was an important matter. He had carried out a large number of tests on synthetic sands, and there was no doubt whatever that when using a pure silica sand with a dead smooth surface there were difficulties in securing the maximum bond; it was much preferable to use a sand which had already roughened or had some small amount of bond firmly adhering to the grains, or even to use sand from the fettling shop, than to use grains which were smooth or had no bond burnt on. This led him to refer to the influence of coal dust. Recently some German investigators had confirmed Mr. Hird's theories as to the function of coal dust, stressing that that function was not merely to generate a gas film to protect the sand grains, but rather to form a tarry or pitchy coating which gave the grains refractoriness and improved their bonding value.

The Paper by Mr. Sheehan, together with that read by Mr. Hudson before two of the Institute's branches during the past session, indicated that the work being done in this country on moulding sands compared very favourably with that of any other country; everyone wished both Mr. Sheehan and Mr. Hudson every success in their experiments.

AUTHOR'S REPLY

MR. SHEEHAN replied to some points raised in the discussion. After thanking the speakers for the kind manner in which the Paper had been received, he said he was quite conscious that there remained still a good deal with regard to the sand question that was open to discussion. With regard to Dr. Skerl's remark that he would have to retrace his steps in a good many cases, Mr. Sheehan said he considered that the Paper represented a step forward, and he would not like to retrace his steps, but would prefer to continue to go forward.

Necessity for Silt Inclusion

With regard to the point raised by Mr. Hudson concerning the patching of synthetic sand, he said he had found, contrary to what was generally accepted, that a certain amount of silt was necessary in a sand. Recently he had been very much relieved when he had received a communication from people in America who used a synthetic bond, to the effect that they were recommending the addition of 4 per cent. of silt, and they specified that the sand should contain 4 per cent. of material that would pass through 100 mesh. In the past we had all been afraid of silt, but its inclusion was necessary in synthetic sands if we had to induce the jobbing-floor moulder to take kindly to synthetic sands. In a mechanical moulding system one was not allowed to patch a mould, and if a mould was defective, a foreman would put his foot through it; but for a jobbing floor, where it might take two or three days to build up a mould, it was necessary to provide a sand that could be patched.

With regard to the fusion points for the synthetic bonding materials, Mr. Sheehan assured Mr. Hudson that the figures were absolutely authentic. The Colbond figures had been determined by Dr. Mellor and the Bentonite fusion points were taken from the published booklet.

Why Facing Sand is Desirable

As to the question why facing sand should be used, he said he was not particularly ambitious to use it, but it was a very easy way of making new additions. One could add fine sand to the facing sand to give a fine finish and one could add the coarser sand additions to backing sand, where a fine finish was not important, for it did not come into contact with the face of the mould. One could make coal-dust additions and bond additions to the facing sand where they were most effective. Whether or not one used a facing sand, it did not add anything to the cost of the sand, because one just made it in one mill and obtained the backing sand from another in a mechanical moulding system; one must have two mills in order to maintain a continuous supply of sand to the circuit. Perhaps there would be no necessity on the jobbing floor if one brought the backing sand to a quality condition equal to that of facing sand; but where one had to use two mills to maintain a continuous supply in a mechanical moulding system, he saw no objection to using one as a facing and the other as a backing sand mixer.

Coal Dust and Sand Grain Surface

Mr. Sheehan acknowledged that the work of Mr. Hird had been an inspiration to him on the sand question in very many ways, even before he

had known Mr. Hird; before he had returned to this country he had read Mr. Hird's communications in THE FOUNDRY TRADE JOURNAL. He agreed that the residue of carbonaceous material on the sand grain was a decided advantage; it was similar to that obtained by precipitating an oxide film on the sand grain. He was not very bigoted about the type of film that was put on to the sand grain, whether it be carbonaceous oxide or hydroxide, or whether it be iron oxide, or aluminium oxide, or manganese oxide, but he considered that some film was necessary on a smooth quartz grain. It certainly increased the bond 10 per cent., which represented a considerable saving in bonding material and in new sand. Perhaps as well as the carbonaceous bond or tarry material that was precipitated on the quartz-sand grain, there was also precipitated a certain amount of coke, and that would be very tenacious. He believed, too, that the finer the coal dust the finer the precipitation on the sand grain and the more tenacious it became.

Use of Reclaimed Sand

Mr. Sheehan expressed the belief that recovered sand was superior to new sand, and that a recovery plant would be necessary in every foundry eventually. He believed the recovered sand which founders had been throwing away was decidedly more valuable than the new sand they introduced. It was purely a matter of getting rid of excess of silt or dirt.

Speaking of the roughening of the grain, he did not intend to put that forward as a practical proposition, although it might be such. He had been looking for a rough-quartz grain, but could not get it conveniently, so that he had had to roughen by hydrofluoric acid, and had been astounded to find a 10 per cent. increase of strength as the result of that alone. There was no film precipitated on this particular grain, but just roughening it increased the surface extension between bond and grain—an increase of 10 per cent. in strength was attained.

Replying to Mr. McClelland, he said he was glad to have written a Paper which the practical man appreciated, because, certainly, he had appreciated the difficulties to be overcome in putting the synthetic-sand system into practice. The foundry referred to in the Paper was not the only one which he had changed over from the use of natural moulding sand to a synthetic sand, but it had offered particular problems, in that he had to operate a steel foundry, a grey-iron foundry and a jobbing floor. Every foundry had its own particular problems, and unless one understood the underlying requirements one would not be able to effect the change-over.

Standardised Sand and Permeability

With regard to the amplification of the formula given for the synthetic sand, he said he had used that particular formula merely to maintain a particular standard of permeability and bond. Any other formula that would have given that result would have been equally welcome and equally usable. There was no treatment of the backing sand as such; it just returned untreated into the system. With regard to the spent core sand, he said he had run for a month by using spent core sand as new-sand additions, and it was true there was some value in the bonding material which had not been burned out in the cores. He had been particularly anxious to take advantage of that; the practice previously was to throw away something which could now be used. It was not necessary to buy any moulding sand, but just to use the core sand as a core sand and then convert it into moulding sand by the addition of a bond.

There had been no difficulty in introducing the synthetic sand into the jobbing floor; he had found that the men there were beginning to use the sand from the grey-iron system on their own initiative. That was a justification for the use of the particular type of synthetic sand introduced, because the jobbing-floor moulder in a good many cases resented these innovations. When he had found the jobbing-floor moulders were using the sand he had been encouraged, and nowadays the sand made up for the grey-iron system had to provide a facing sand for the jobbing floor. He was introducing this type of sand also for the steel foundry—he did not use the coal-dust additions in steel moulding sands.

Control Considerations

Commenting on Mr. Cooper's remarks, he said the only new sand additions that he intended to make ultimately were those necessary to make up the losses on the castings as such, *i.e.*, the sand burnt into the runners or into the castings and carried away in castings. Of course, the new additions he had made were to introduce bond and to regulate the permeability; when one had the bond independent of the grains of sand, and the grains of sand were predetermined by the core requirements, one could very readily control both permeability and the bond.

He was completely in agreement with Mr. Neath that iron oxide as such was not important. He had tried iron oxide additions without burning them on, and had had a bond, although not so good as any of the synthetic bonds that were otherwise available. He was not insistent about the type of pellicle around the sand grain. He did not care whether it was ferruginous, or manganese or aluminium oxide, so long as one got it around the sand grain, by any method. Some of the methods mentioned, such as introducing manganese resinate into the core oil and burning that resinate to a manganese oxide, introduced a pellicle around the sand grain which was very valuable in steel work. He exhibited a sample of a sand with manganese oxide burned on, which was equally as valuable as one with iron oxide burned on, as regards bond strength, and he pointed out that Mr. Hird had found that a carbon bond burned on would be also valuable. He considered that the surface condition of the grain was more important than what was added as bonding material, provided the bonding material met one's requirements in giving sufficient green- and dry-sand strength.

Mixing Speeds and Composition

Dr. Skerl had said that his foundry was at one time in the grip of American practice. It was in the grip of an American practice applied wrongly to British conditions. Though he (Mr. Sheehan) had a good deal of American prejudices himself, he considered that British moulding-sand practice was superior in many ways to the American. But the Americans had to meet the difficulty that they were deficient in natural moulding sand resources and they had to turn out sufficient sand for a moulding system to meet the enormous productions in that country. With the additions of synthetic bonds one could mix within a minute, or 1½ min. or 2 min., but if using natural moulding sands one had very often to mill them for a period of from 7½ to 10 min. That would not be permissible in a mechanised moulding system such as those existing in America, producing 12,000 monoblocs in two shifts (16 hrs.).

Mr. Sheehan said he was rather keen on the factor of refractoriness. Both Mr. Hudson and Dr. Skerl had stated that refractoriness did not matter so much in a moulding sand; but he could not operate in the steel foundry with a red sand, because a portion of the sand became fusible actually, and although he had had excellent slag traps in the mould, slag was developed near the runner and washed into the mould. It might be possible to run a steelfoundry with red sand, but he did not see the necessity for so doing when one could obtain much more refractory sands quite easily and as cheaply.

Sieves

As to the statement that the I.M.M. sieve was no longer standard in this country, he said he was not bigoted even about sieves; he did not think it mattered very much whether one had an I.M.M. or B.S.I. sieve, or Tyler sieves from America, so long as one interpreted the figures from them, and when one got good results with sand that was retained on the 70 mesh of the I.M.M., one should maintain that condition. It was valuable from the point of view of exchanging ideas and information to keep to a particular standard sieve, however.

Dealing with some of the samples exhibited at the meeting, Mr. Sheehan said one was a Belgian sand made into a red sand by burning on some of the iron oxide existing in the Belgian sand. It could easily be washed. Another was a red sand washed with water, but he could not wash from it the ferruginous bond, which was very valuable in red sands. He could take it off by hydrochloric acid and leave a perfectly clear silica sand. On another sample he had superimposed or precipitated the ferruginous bond. On another was precipitated a pellicule of manganese oxide.

Vote of Thanks

MR. J. W. GARDOM, who said he was responsible for securing the Paper, proposed a hearty vote of thanks to Mr. Sheehan for it. Its value could be gauged largely by the fact that it had invoked so spontaneous a discussion. Perhaps the author might have made it more clear that he was using the sand referred to in a mechanical system, for it appeared that some of those who had discussed the Paper were probably thinking of its use in ordinary floor moulding. It had been pointed out that natural sand could not be prepared quickly enough in a mechanical foundry, and that statement covered the point made that the sand that was used in the foundry, before Mr. Sheehan had got to work there, was not suitable. Reference had also been made to permeability being too high, a statement which appeared to be a little exceptional. Finally, Mr. Gardom expressed the hope that the work which had been started on sand testing in this country, and which had been carried a stage further by Mr. Sheehan, would continue.

MR. H. WINTERTON (Junior Vice-President) seconded the proposal. Discussing some of his own experiments, he said that with one artificial bond he had turned out three blends, one with the ordinary sand and two with artificial sand, and one could be excused for choosing the latter as having been made with the original sand. He looked forward to the time when we might be able to say that the same sand was being used in foundry year after year, and that there would be no more difficulties in deciding where to dump it. We should by that time have solved the problem of perpetual motion. Finally, Mr. Winterton said that he could promise Mr. Sheehan a very lengthy and exhaustive discussion by the Scottish Branch if he would present such a Paper there.

The vote of thanks was carried with acclamation.

MR. SHEEHAN, in a brief response, said the reception of his Paper had amply compensated him for the trouble he had gone to in preparing it.

DURING THE first four months of the current year pig-iron output in Rumania increased by 35 per cent., while prices declined by 7 to 8 per cent. as compared with a year before, although ore supplies are not easy to maintain and imports are largely on an exchange basis. At the beginning of the year two blast furnaces were lit and a third new furnace is to be started up by the Titan-Nadrag-Kalan works in August. As the demand for pig-iron is steadily rising it is expected that the State works at Hunedoara will put a further new furnace into blast this winter. Steel output of the Reschitza works is expected to reach 150,000 tons this year, against 110,000 tons in 1933. The production of the Titan-Nadrag-Kalan works will probably total 65,000 tons.

A Report of the Work of the Cast Iron Sub-Committee of the Technical Committee

(*Concluded from page 409, Vol. 50.*)

Conclusions from Physical Tests

Tensile Strength.—Total carbon is the most important factor in controlling tensile strength, and figures taken from the graphs at a constant phosphorus show appreciable reductions in strength as the carbon increases from 2.6 to 3.6 per cent., though the reduction is not so marked in the higher phosphorus irons as it is in the low phosphorus irons. Similarly the effect of increasing phosphorus is to decrease the strength of the iron, this effect becoming less with increased carbon until, with carbon about 3.6 per cent., phosphorus has little effect on the strength. Thus irons having the greatest tensile strength are those having low carbon and phosphorus, carbon being the more important.

Transverse Strength.—In the transverse tests a very similar effect is noted with increasing total carbon and similar reductions occur. In these tests the effect of phosphorus is, however, more marked. Taking a broad view of the results, low phosphorus irons have a higher transverse rupture strength than the higher phosphorus irons irrespective of the carbon, though the lower the carbon the greater the difference. Thus again, low carbon, low phosphorus irons have the greatest transverse strength, but in this case phosphorus is a rather more important factor than carbon.

Deflection in Transverse.—Phosphorus appears to be the deciding factor in this connection, deflection decreasing with increasing phosphorus in all cases. Total carbon appears to have little effect.

Brinell Hardness.—Brinell hardness rises with decreasing total carbon, and also, though to a lesser extent, with increasing phosphorus.[13]

It is obvious that the graphitisation of the iron plays an important part in the strength, etc., of irons, and this is influenced to some extent by factors other than those disclosed by analysis, differing results being obtained with irons of the same analysis. The sub-committee has had evidence in these tests that where a different brand of pig-iron was accidentally introduced, results were obtained quite out of step with the remainder of the series, although analysis disclosed no difference. Thus in experiments involving the mixture of two different types of pig-irons, the effect of the introduction of a second pig with different graphitisation properties may entirely offset any results anticipated from the change of analysis. (See Series X.)

In the above conclusions it must be borne in mind that, on the whole, irons with silicon about 2 per cent. have been under examination, and so these conclusions do not necessarily apply to irons of different silicon content, etc., except that it has been demonstrated that silicon from 2.0 to 3.2 per cent. has little effect on low carbon irons. (Series IV and V.)

With regard to the "dangerous range" and physical properties, it is agreed that with certain carbon contents the strength of cast iron is maintained up to 0.3 per cent. P with a falling off thereafter. There is some slight evidence of a slight increase of strength with phosphorus above about 0.8 per cent.

It is obvious that in any discussion as to the existence of a dangerous range, total carbon must be borne in mind, and the sub-committee is of the opinion that any experiences of bad results having been obtained by reducing phosphorus from 0.7 to 0.5 per cent. are due to the incidental increase of carbon induced by the employment of low phosphorus irons, and where these troubles have been obviated by still further reducing the phosphorus to 0.3 per cent., the improvement is due to the phosphorus *per se*.

The committee have not investigated the hair crack troubles referred to by Cook, but no difficulty with this was experienced in any of their experiments. The experience of members of the sub-committee has been that these troubles are more related to casting strains, particularly those produced by thin flashes, and are not materially affected by the composition of the metal except to the extent that if the composition is such that the iron will chill white in the thin section of the flash, this trouble is greatly increased. The evidence with regard to the effect of phosphorus on chill is rather conflicting.[7, 13]. However, in view of the fact that neither high carbon hematites nor thin flashes were concerned in the instances given by Cook, it is difficult to give any explanation of this evidence of a "dangerous range."

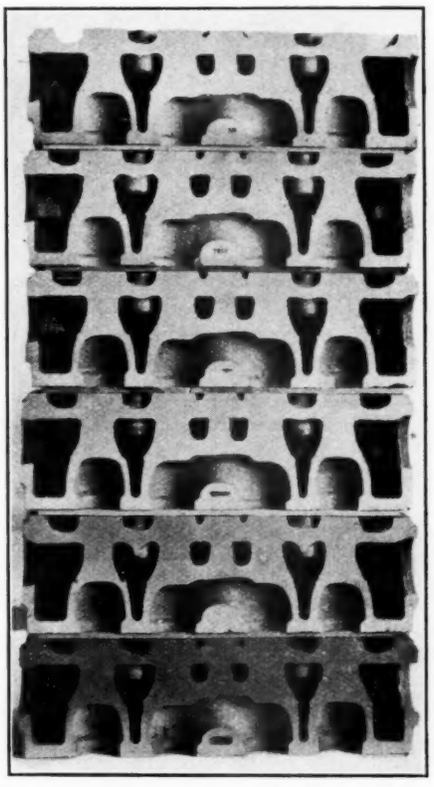


FIG. 8.—SERIES IV. SECTIONED CYLINDER HEADS. T.C. 2.6; Mn 0.9; S 0.025 and P 0.8 with increasing silicon.

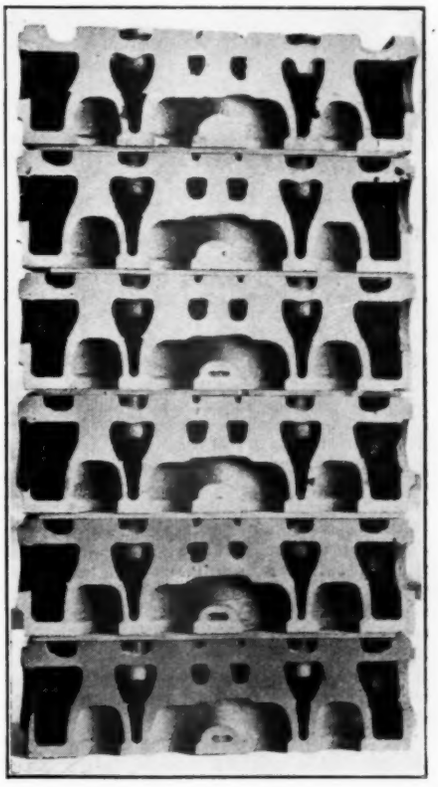


FIG. 9.—SERIES V. SECTIONED CYLINDER. HEADS T.C. 2.6; Mn 0.90; S 0.025 and P 0.06 with increasing silicon.

TABLE I.—*Contraction related to Composition and Casting Temperature.*

T.C.	Analysis.					Approx. pouring temp. deg. C.	Contraction ins. per ft. (Average of 2 bars).	
	C.C.	Si.	Mn.	S.	P.		12-ft. bar.	4-ft. bar.
A 3.30	0.62	2.03	0.72	0.110	0.79	1,400	0.150	0.155
A 3.30	0.62	2.03	0.72	0.110	0.79	1,350	0.150	0.158
A 3.30	0.62	2.03	0.72	0.110	0.79	1,325	0.153	0.155
C 3.20	0.65	1.50	0.70	0.090	0.80	1,350	0.158	0.158
C 3.15	3.15	0.75	0.70	0.110	0.80	1,350	0.237	0.241
C 3.15	3.15	0.75	0.70	0.110	0.40	1,350	0.227	0.250
A 3.45	0.35	2.75	0.95	0.090	1.45	1,350	0.148	0.156
A 3.60	0.45	2.15	0.75	0.080	0.05	1,350	0.142	0.139

NOTES.—A = Actual analysis. C = Calculated analysis. Optical pyrometer used.

Contraction

The sub-committee came to the conclusion that it was impracticable to study the influence of analysis, section and pouring temperatures on the linear contraction of cast iron for the following reasons:—(1) Variations of contraction are so slight that it is impossible accurately to measure differences in bars of about 12 in. length, and longer bars are difficult to make as routine.

(2) Unless tests made in different foundries are made under exactly similar conditions of moulding, such as sand moisture, ramming

density, section of chill yoke used, etc., the results will vary.

(3) The principal element in controlling contraction is the graphite, and it is well known that similar analyses and moulding conditions do not produce the same graphitisation of raw materials of different history.

A member undertook to investigate the contraction of bars 4 ft. and 12 ft. long at differing pouring temperatures and with different compositions. This was done by ramming up patterns of 1 in. sq. steel bar between machined chills 12 in. × 4 in. × 2 in., two patterns in a box. The bars were run direct in the centre with relief risers near each end. The contraction was measured both by wedge before withdrawing from the mould, and by comparing with the length of the original pattern, only a slight difference being noted between the readings obtained by both methods.

The results are set out in Table I.

It would appear that temperature influences are not too marked until a very low point is reached. When metal was poured at a temperature bordering on freezing, a badly distorted casting resulted.

From the variations in the figures, the sub-committee's difficulties in obtaining accurate measurements on shorter bars will be appreciated.

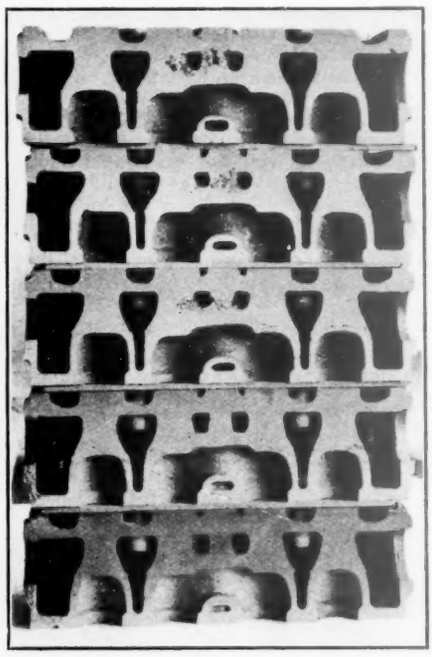


FIG. 10.—SERIES VI. SECTIONED CYLINDER HEADS. Si 1.9; Mn 1.0; S 0.02 and P 0.86 with increasing Total Carbon.

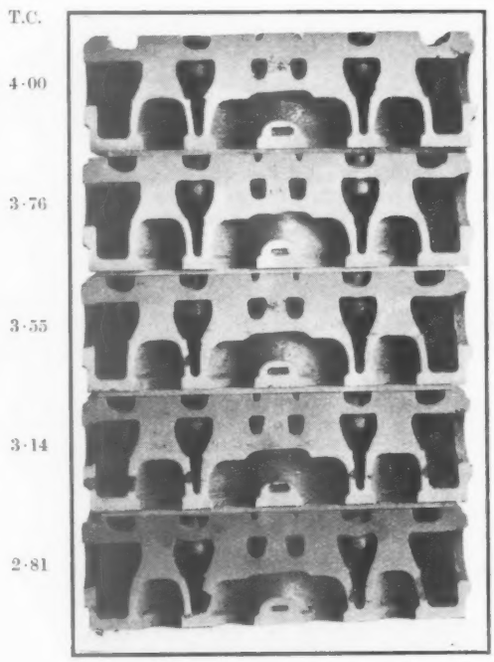
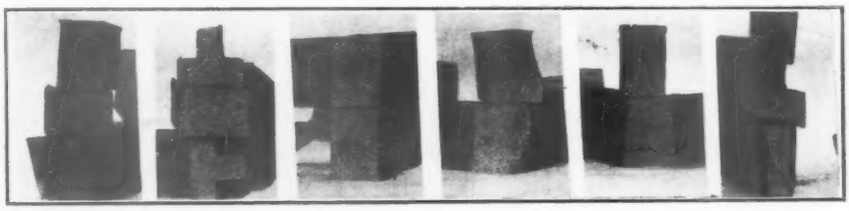


FIG. 11.—SERIES VII. SECTIONAL CYLINDER HEADS. Si 1.9; Mn 1.0; S 0.022; P 0.16 with increasing Total Carbon.



T.C. 3.61; P 0.06. T.C. 3.70; P 0.28. T.C. 3.64; P 0.44. T.C. 3.37; P 0.58. T.C. 3.40; P 0.89. T.C. 3.21; P 1.13.

FIG. 12.—SERIES X. T-TESTS. Si 2.35; Mn 0.7, and S 0.05 per cent. with varying carbon and phosphorus.

Cokes used in Carbon Pick-up Experiments.

Cokes used.	Moisture.	Ash.	Volatile.	Sulphur.	Shatter.	
					2 in.	1½ in.
	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.	Per cent.
No. 1..	Less than 1	9.2	1.25	0.56	80	85
„ 2..	„ 1	9.2	1.25	0.56	89	93½
„ 3..	„ 1	6.1	2.50	0.75	91.9	94·7

(Shatter figures are the amounts remaining on a sieve of the mesh stated after 4 drops of 6 ft.)

Carbon Pick-Up

To explore the effect of different qualities of coke on carbon pick-up, certain experiments have been made. Three different grades of iron were melted in a small experimental cupola with three different grades of coke. Cupola conditions were kept constant in each melt, a constant weight of coke being used and the return coke deducted to arrive at the consumption. Five cwts. of pig-iron were melted in each test, the metal being tapped in three taps and each tap analysed. There was little variation between the analyses of the taps, and the average gains and losses are given.

The results of these experiments are set out in Table II. The sub-committee does not wish to comment on them at present, as they feel that further confirmatory work is required with other types of cupolas before definite conclusions can be drawn, but they publish them to show that a very useful line of investigation is being pursued and that there are possibilities of determining the relation of carbon pick-up to the shatter value and reactivity of coke.

B.S.I. Specification 321/28

This specification having been in force more than five years, the sub-committee feels that the time is now ripe for reviewing its position. The sub-committee has done no work in connection with this, but it is suggested that this is the next problem that should be undertaken, and certain points are included in this report in the hope that the discussion will express the feeling of foundrymen in general, and give the sub-committee a lead as to the prosecution of its future work.

The principal comments that the sub-committee wishes to make, and upon which it desires discussion, are:—

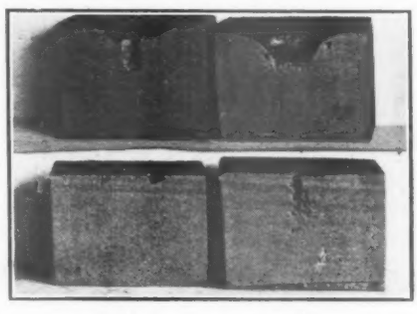
(1) The sub-committee wholeheartedly approves of the principle of varying-size test-bars to represent varying sections of castings, and notes with gratification that the new American specification has adopted this principle.

(2) Certain practical difficulties have arisen in breaking the bars. In the transverse test, trouble is experienced through the round bars rolling if not perfectly straight or round, and faulty deflection readings are obtained by the high loads necessary for the large bars, causing the knife edges to dig into the bar. Difficulties are encountered in breaking the "L" tensile bars, as not many machines are equipped with suitable grips for holding large bars, and with the advent of high-strength irons many machines are incapable of applying the necessary stress.

(3) The sub-committee feel that the time has now come for a further grade of higher strength to be included.

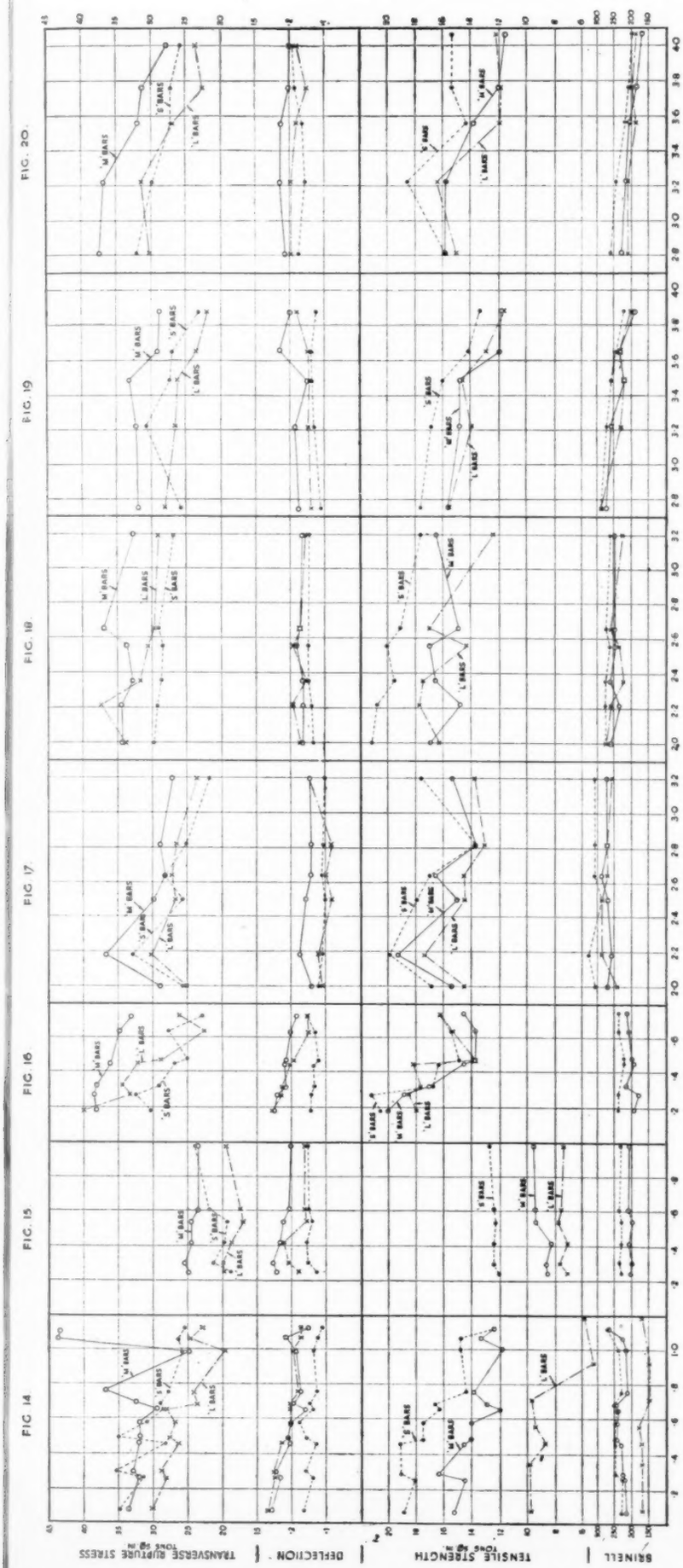
It is unfortunate that the grades have been labelled "A" and "C," for it is difficult to see how a suitable designation for an improved grade can be introduced into the present specification. The American and German specifications provide for irons of much higher strength, and the designation of the various grades permit of further additions as and when necessary.

P 0·27 P 0·93



P 0·25 P 0·98

FIG. 13.—BLOCKS SHOWING LIQUID SHRINKAGE. *Top.*—T.C. 2.6; Si 1.9; Mn 0.9 and S 0.045 per cent. *Bottom.*—T.C. 3.6; Si 2.0; Mn 1.9 and S 0.04 per cent.



% PHOSPHORUS. SERIES I — T.C. 3.3; Si 2.1; Mn 0.87; S 0.046; Cr 0.3 with increasing Phosphorus.

% PHOSPHORUS SERIES II — T.C. 3.6; Si 2.0; Mn 1.9; S 0.045 with increasing Phosphorus.

% PHOSPHORUS SERIES III — T.C. 2.6; Si 1.9; Mn 0.9; S 0.066 with increasing Phosphorus.

% SILICON SERIES IV — T.C. 2.6; Mn 0.9; S 0.025; P 0.8 with increasing Silicon.

% SILICON SERIES V — T.C. 2.6; Mn 0.9; S 0.025; P 0.06 with increasing Silicon.

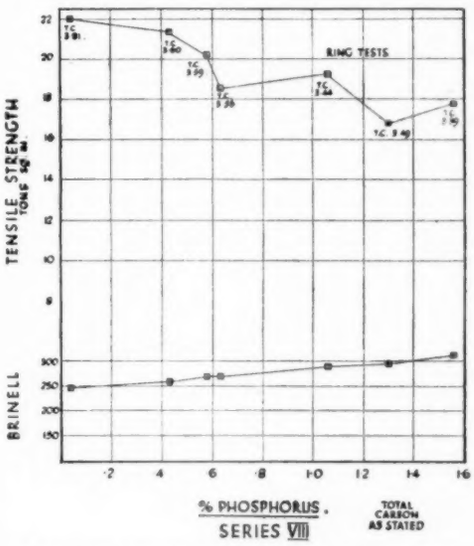
% TOTAL CARBON SERIES VI — Si 1.9; Mn 1.0; S 0.022; P 0.86 with increasing Total Carbon.

% TOTAL CARBON SERIES VII — Si 1.9; Mn 1.0; S 0.022; P 0.16 with increasing Total Carbon.

FIGS. 14 TO 20.—INFLUENCE OF INCREASING PERCENTAGES OF CONSTITUENTS ON THE MECHANICAL PROPERTIES OF CAST IRON.

(4) The extent to which the specification has been adopted is disappointing, and propaganda must be developed to encourage its use.

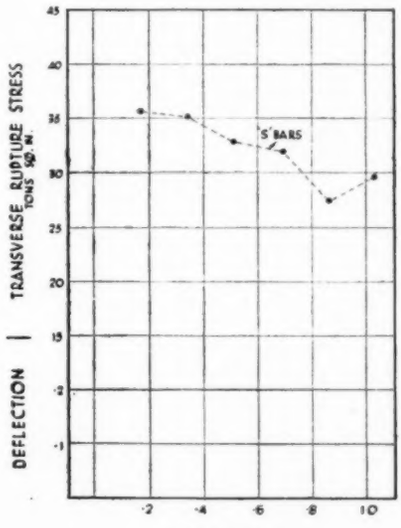
(5) The sub-committee have definitely adopted the method of expressing transverse strength as transverse rupture stress (modulus of rupture),[14] and hopes that this will ultimately become



Si 2.4; Mn 1.0; Cr 0.6 with increasing Phosphorus.

FIG. 21.—INFLUENCE OF PHOSPHORUS ON THE TENSILE STRENGTH AND BRINELL HARDNESS OF CHROME CAST IRON (CENTRIFUGALLY CAST).

common amongst specifying authorities. In order to facilitate the conversion of transverse test results into transverse rupture stress, factors have been calculated to give the correct figure for bars which vary within ±0.1 in. of the correct size, and are set out in Appendix I.



T.C. 3.0; Si 1.20; Mn 1.1; Ni 2.0 with increasing Phosphorus.

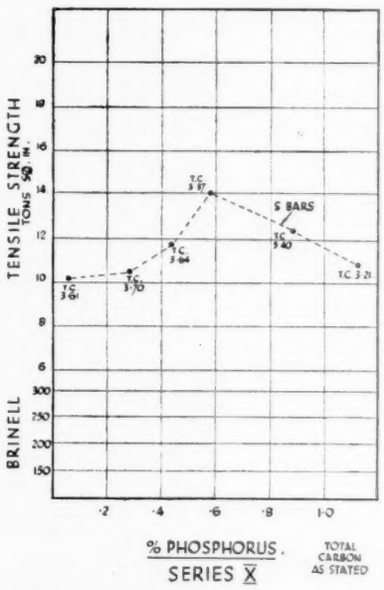
FIG. 22.—INFLUENCE OF PHOSPHORUS ON THE TRANSVERSE STRENGTH OF NICKEL CAST IRON.

This Appendix also gives the factors for calculating the rupture stress of rectangular bars.

(6) The physical tests given earlier in this report are interesting in that they give tensile and transverse results for all sizes of bar on a wide range of irons. The low value for the transverse rupture stress of "S" bars as compared with the "M" and "L" bars which is

brought out in these graphs will have to be investigated.

In conclusion, the committee wish to thank the following firms for giving facilities for carrying



Si 2.35; Mn 0.7; S 0.05 with increasing Phosphorus.

FIG. 23.—INFLUENCE OF PHOSPHORUS AND CARBON ON THE TENSILE STRENGTH OF CAST IRON.

out the experiments, etc., detailed in this report:—

Bradley & Foster, Limited.
Craven Bros., Limited.
Keighley Laboratories, Limited.
Leyland Motors, Limited.
Mond Nickel Company, Limited.
S. Russell & Sons, Limited.
Sheepbridge Stokes Centrifugal Castings Company, Limited.

TABLE II.—*Analysis Variation with Different Cokes.*

Original pig-iron.	Gains or losses with coke.		
	No. 1.	No. 2.	No. 3.
T.C. 2.50	+ 0.417	+ 0.320	+ 0.183
Si 2.54	− 0.107	− 0.114	− 0.187
Mn 0.94	− 0.170	− 0.147	− 0.214
S 0.05	+ 0.021	+ 0.017	+ 0.010
Coke consumption, lbs.	158	156	138
Time of blow, mins.	36	30	25
T.C. 3.00	+ 0.080	+ 0.103	+ 0.050
Si 2.35	− 0.284	− 0.124	− 0.264
Mn 1.00	− 0.214	− 0.210	− 0.27
S 0.054	+ 0.017	+ 0.019	+ 0.013
Coke Consumption lbs.	166	158	136
Time of blow, mins.	30	27	30
T.C. 3.21	+ 0.110	+ 0.040	+ 0.016
Si 2.47	− 0.130	− 0.184	− 0.21
Mn 1.20	− 0.183	− 0.174	− 0.23
S 0.048	+ 0.006	+ 0.006	+ 0.004
Coke consumption lbs.	164	166	136
Time of blow, mins.	32	30	30

They are also indebted to the Rugby College of Technology for carrying out some of the tensile tests on the "L" bars, and to the British Cast Iron Research Association for access to their Library for certain published data.

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APPENDIX

Factors for determining Transverse Rupture Stress from Breaking Load on Round Test-Bars according to B.S.I. Specification 321/28.

$$\text{Rupture Stress} = \frac{\text{Breaking load} \times \text{Distance between supports}}{0.392 \times \text{Diameter}^3}$$

The factors given below are for the three sizes of test-bar and the rupture stress is determined as follows:—

Breaking load in tons × Factor = Rupture stress in tons per sq. in.

L bar. Nominal dia. 2.2 in. tested on 18 in. centres.		M bar. Nominal dia. 1.2 in. tested on 18 in. centres.		S bar. Nominal dia. 0.875 in. tested on 12 in. centres.	
Actual diameter at fracture in ins.	Factor.	Actual diameter at fracture in ins.	Factor.	Actual diameter at fracture in ins.	Factor.
2.100	4.96	1.100	34.4	0.775	65.7
2.110	4.89	1.110	33.6	0.785	63.2
2.120	4.82	1.120	32.7	0.795	60.8
2.130	4.76	1.130	31.9	0.805	58.5
2.140	4.69	1.140	31.0	0.815	56.3
2.150	4.62	1.150	30.2	0.825	54.2
2.160	4.55	1.160	29.4	0.835	52.4
2.170	4.48	1.170	28.7	0.845	50.7
2.180	4.42	1.180	28.0	0.855	49.0
2.190	4.36	1.190	27.3	0.865	47.3
2.20	**4.30**	**1.20**	**26.6**	**0.875**	**45.7**
2.210	4.24	1.210	25.9	0.885	44.2
2.220	4.19	1.220	25.3	0.895	42.8
2.230	4.14	1.230	24.7	0.905	41.4
2.240	4.08	1.240	24.1	0.915	40.0
2.250	4.03	1.250	23.5	0.925	38.7
2.260	3.98	1.260	22.9	0.935	37.5
2.270	3.92	1.270	22.4	0.945	36.3
2.280	3.86	1.280	21.8	0.955	35.2
2.290	3.81	1.290	21.4	0.965	34.1
2.300	3.77	1.300	20.9	0.975	33.1

For square or rectangular test-bars the formulæ for the conversion of breaking load into rupture stress are:—

For 2 in. × 1 in. bars on 36 in. centres:

Corrected load (in cwts.) × 0.675 = Rupture stress (tons per sq. in.).

For 1 in. × 1 in. bars on 12 in. centres:

Corrected load (in cwts.) × 0.9 = Rupture stress (tons per sq. in.).

The breaking load should be corrected for actual size of bar at fracture in accordance with the following formulæ:—

For 2 in. × 1 in. bars on 36 in. centres:

$$\text{Corrected breaking load} = \frac{4 \times \text{Actual breaking load.}}{\text{width at fracture in in.} \times (\text{depth at fracture in in.})^2}$$

For 1 in. × 1 in. bars on 12 in. centres:

$$\text{Corrected breaking load} = \frac{1 \times \text{Actual breaking load.}}{\text{width at fracture in in.} \times (\text{depth at fracture in in.})^2}$$

CAST IRON SUB-COMMITTEE OF THE TECHNICAL COMMITTEE OF THE INSTITUTE OF BRITISH FOUNDRYMEN.

P. A. Russell, B.Sc., *Convener.*

L. W. Bolton, A.M.I.Mech.E. — E. Longden.
A. B. Everest, Ph.D. — F. K. Neath, B.Sc.
B. Hird. — W. West.
J. E. Hurst. — A. S. Worcester.

J. W. Gardom, *Convener, Technical Committee.*

French Foundry Association

PROVISIONAL PROGRAMME OF THE THIRTEENTH FOUNDRY CONGRESS

The thirteenth annual congress of the Association Technique de Fonderie will be held at Nancy on Friday and Saturday, July 20 and 21. The following Papers, which are provisionally announced, will be divided to best advantage among the sessions when the definite programme is established.

Exchange Papers

Exchange Paper from the Institute of British Foundrymen, Mr. E. Longden, foundry manager, Craven Brothers, Redditch, Manchester: *Some factors which influence the density and soundness of iron and non-ferrous castings.*

Exchange Paper from the American Foundrymen's Association, Mr. H. Walther, of the Dayton Steel Company, Dayton, Ohio: *Study on the fabrication of cast and electric iron.*

Exchange Paper from the Belgian Foundry Technical Association: *Influence of linseed oil used in sand preparation, and its result on the texture and mechanical properties of cast iron.*

Exchange Paper from the Czecho-Slovakian Foundry Technical Association, Prof. Pisek (*the subject has not yet been communicated*).

Other Papers

Dr.-Ing. Mayersberg, of Berlin (*the subject has not yet been communicated*).

Dr.-Ing. Nipper, of the Aix-la-Chapelle Foundry Institute: *Influence of the increasing proportions of water and clay on the properties of oil cores.*

Dr.-Ing. Sonchen, of the Aix-la-Chapelle Foundry Institute: *Some physical properties of cast iron, with special reference to magnetic, electric and heat-conducting properties.*

Prof. Seigle, of Nancy: *Results of new researches on the metallography of carbon steels: construction of an equilibrium diagram.*

Mr. Sarra, engineer, Société de Pont-à-Mousson: *The cutting properties of cast iron with relation to its chemical composition.* (This Paper will be illustrated by annotated films taken and commented upon by the author.)

Mr. Travers, director of the Nancy Chemical Institute: *Rapid calorimetric estimation of silicon in cast iron; method of estimating the addition of more usual elements* (with experiments).

Commandant Nicolau, President of the A.T.F. Committee on Methods of Testing: *Notes on the methods of mechanical appraisement of foundry products.*

Mr. Duez, chemical engineer at the Etablissements Cail, Denain: *The separation of titanium and vanadium and their appraisement in titano-vanadium cast irons.*

Mr. Collas, engineer, Société de Pont-à-Mousson: *Contribution to the microscopic study of phosphorus cast irons by the method of Stead-Kunkele* (with coloured cinematograph slides).

Dr. Delbart, departmental manager, Etablissements Cail, Denain (*the subject has not yet been communicated*).

Mr. M. L. F. Girardet, President of the Association Technique de Fonderie and President of the Sand Committee: *Present state of the question of moulding sands; rapid clinical method of determining the methods of application* (practical demonstration and exhibition of apparatus).

Mr. Satet, manager of the scientific department of the Union of Metallurgical and Mineral Industries, Paris: *Works budget.*

Mr. A. Le Thomas, Vice-President of the Association Technique de Fonderie, director of the Foundry Research Centre of the Saulnes Blast-Furnace Company: *Auto-annealing of cast irons hardened in their chills.*

A Discussion on Steel Castings

The Paper which MR. MERCER and MR. BARCLAY read before the Middlesbrough Branch of the Institute and was published in our issue of May 31, 1934, produced the following discussion.

Frozen Tuyeres

MR. EDWARDS said he was sometimes troubled with "frozen tuyeres," and he would like to ask the authors if they knew of any method for getting over the trouble.

MR. BARCLAY replied that trouble of that description was not confined to any one foundry. He believed the best method of reducing it to a minimum was to start the day with good hot iron of fairly high silicon content. "Frozen tuyeres" in Bessemer practice were usually associated with heats difficult to bring on the "boil."

Quenching Temperatures

MR. PLANT was of opinion that the 30 deg. C. above $A.C._3$ given by the authors as a suitable annealing temperature was on the low side. Personally, he preferred 50 or 100 deg. C. above $A.C._3$. He also thought that the increased mechanical properties mentioned in connection with quenched steels were not so much attributable to refinement from quenching as to the fact that a new constituent was introduced.

MR. BARCLAY, in reply, said he presumed the new constituent referred to was sorbite. He did not altogether agree that the new constituent was entirely responsible. Experience had shown that the best combination of strength, ductility and toughness were obtained by quenching to produce a homogeneous structure of martensite, but, whilst it was true that sorbite was the characteristic constituent of tempered or toughened steel, it must not be forgotten that to produce the predominant Martensitic structure, cooling velocity and quenching medium played an important part in the quality of the ultimate mechanical tests.

With regard to annealing temperatures, there had been no stipulation on temperatures above $A.C._3$, but he considered 100 deg. C. above $A.C._3$ too high. Whilst it was difficult on occasion to break up the "as-cast" condition, he was of opinion that high annealing temperatures followed by slow cooling encouraged recoarsening. Normalising, of course, demanded a higher temperature than annealing.

Carbon Control

MR. SCHOLES asked if the authors were in favour of blowing right down or catching the carbon coming down, as he understood was common to Swedish practice. Had the authors any experience of titanium as a deoxidiser? Were the authors aware of any method for rectifying the dendritic structure so often associated with excessive casting temperatures? Could the authors give comparative results of Izod tests on electric and converter steels?

MR. BARCLAY stated that he preferred to blow right down, as it seemed to him the only method for accurate control of analyses. He was aware that certain people claimed to be able to estimate the carbon content of the bath by a sight of the flame, but they were certainly not working to a plus or minus 0.02 per cent. specification. With regard to titanium, he had found it a very efficient deoxidiser as a final addition to the ladle; he had used it in place of aluminium.

The dendritic structure was a difficult structure to break down, not only in carbon-steel castings but in some alloy steels, and upon that factor they depended for bringing out the best qualities. He had found this structure on occasion to persist after a very drastic heat-treatment consisting of a high-temperature quenching followed by annealing just over $A.C._3$.

He could give no comparative figures for electric and converter steels, but taking into consideration the exceptional tests obtained on well-made converter steels, he thought converter steels would compare favourably in that respect with steel made by other processes.

Desulphurisation

MR. COTTEN asked if the authors had any preference in deoxidisers. Did they use soda ash as a desulphuriser, and, if so, with what success?

MR. BARCLAY stated that until recently they had always preferred 70 per cent. ferro-silicon and 80 per cent. ferro-manganese, preheated before adding to the bath; they had no reason to complain either from an analysis or inclusions point of view if the alloys were allowed time to do their work. He would say, however, that since the publication of the work of Herty, he had tried a silicon-manganese in which the manganese-to-silicon ratio was 4 to 1. Experiments with silico-manganese are still in progress. With regard to soda ash as a desulphuriser he could say that, used as recommended, there was no difficulty in keeping the steel sulphurs in the vicinity of 0.045 per cent. The best way to add the soda ash to the cupola-melted charge for the converter was intimately to mix the requisite proportions of soda ash and lime before filling the empty iron ladle.

Electrical Carbon Testers

MR. RIDSDALE asked if the authors had any information on an electrical apparatus used in America for estimating the carbon content of the bath during the combustion of the CO to CO_2. He had heard that a sample could be drawn from the converter and the carbon estimated in two minutes. He would also like to know how the authors controlled the permeability of the moulding sands. Were hardness tests taken from the faces of moulds?

MR. BARCLAY replied that he had no information on the carbon-testing apparatus; he could not see any advantage in its use. Presumably, the vessel was turned down for the sample to be taken and remained in that position until the carbon result was obtained; unless the carbon was caught as desired on the first sample, further samples would be necessary, thus causing further delay. On the other hand, supposing the carbon was lower than expected or wanted, it still meant "pigging back."

Sand Control

MR. MERCER replied to Mr. Ridsdale's questions on sand. The permeability of the facing sand was not tested in actual practice at the mixing plant. The results obtained on the castings dictated the policy with regard to mixing, as stated in the Paper. Good permeable sand could be spoiled by too-liberal use of the water brush, or having badly-mixed sand for a backing. The surface of the moulds were not tested for hardness: he thought it quite unnecessary in steel-foundry practice.

Heat-Treatment Plant

MR. CHARLTON asked the procedure the authors adopted when quenching castings, and was there any restriction with regard to carbon content of the castings? Did the authors prefer oil or water as the quenching medium?

MR. BARCLAY replied that the best arrangement had the quenching tank so placed that the castings could be transferred from furnace to tank with as little handling as possible. Castings which had no previous heat-treatment were quenched at normalising temperatures, but if they had been previously normalised a lower temperature was quite suitable, say 30 deg. C. lower. Quenching temperatures were, of course, governed by analyses. Probably the best mechanical tests were obtainable by using water, but the risk of quenching-cracks was reduced by using oil.

With regard to carbon content, he thought most requirements for hardened and toughened carbon-steel castings would be covered by a range up to 0.60 per cent. carbon, but it was not altogether a question of carbon content which decided the suitability of a casting for this treatment. One had to consider design and section.

Ladle Developments

MR. WOOLEY asked the authors if they had any experience with the tea-pot ladle; he had seen it, and believed it was being increasingly used, on the Continent.

MR. MERCER replied that he had no actual experience of its use in steel, but believed it was being used to some extent for cast iron, especially irons which had been desulphurised with soda ash. It was particularly adaptable for cast irons so treated, as the syphoning spout was carried to within a few inches of the bottom of the ladle, thus obviating the necessity for the very careful skimming required when using a lip-pouring ladle.

MR. CHARLTON remarked that the slide on contraction had shown the contraction for length but had omitted to show the contraction for width.

MR. MERCER replied that in the width of the sample cast the contraction was normal, *i.e.*, 1 in 60.

MR. FOSTER asked whether the authors used bottom-pouring ladles or cast over the lip.

MR. BARCLAY replied that bottom-pouring ladles were used. Notwithstanding the fact that a fresh ladle was required for each heat, he believed the advantages of bottom pouring outweighed the increased cost over lip pouring. In the bottom-pouring ladle the slag was undisturbed on top of the steel, inclusions had a better chance to rise, the steel to the mould was free from slag and pouring speeds were easy to regulate. The lip ladle certainly had one advantage in the fact that one had a view of the steel and more control over casting temperatures, but, no matter how carefully skimming was done, the slag could not be entirely kept back.

Feeding Blank Wheels

MR. COTTON asked what would be the procedure in regard to feeding heads on a blank wheel. He had in mind draws encountered during teeth cutting. He would like to know if the authors had any suggestions for overcoming trouble of that description.

MR. MERCER replied that the only reliable method was to put a "muck ring" or feeding ring all the way round the outside rim of the wheel. The ring to take the shape of a "V," round heads are placed at intervals on the ring. A sketch illustrating the reply was drawn on the black-board.

Catalogue Received

Foundry Supplies. Messrs. H. G. Sommerfield, Limited, of Charterhouse Chambers, Charterhouse Square, London, E.C.1, in a foreword to their latest catalogue, have stressed the reasons for producing it in the form of a loose-leaf publication. We endorse their arguments, which are based on the ever-changing requirements of the modern foundry. Moreover, their business is largely the supply of consumable stores for the foundry industry, and in this direction fashions change reasonably rapidly. The catalogue is divided into nine sections, which cover pig-iron, sands and fuels, refractories and melting appliances, general foundry requisites, sand-blast plant, pattern-shop supplies, protective clothing, pneumatic tools and miscellaneous. Wherever practicable, prices are quoted and insertion of chatty remarks about each article, certainly removes something of the "dry-as-dust" atmosphere one usually associates with price lists.

XUM

Institute of Metals

TWENTY-SIXTH AUTUMN MEETING, SEPTEMBER 3-6, 1934

In arranging for the Autumn Meeting to be held in Manchester this year, the Institute of Metals is planning its third visit to that city, previous autumn meetings having been held in Manchester in 1909 and 1923. On each occasion a highly-successful meeting took place. The Local Executive Committee, under the chairmanship of Dr. A. G. C. Gwyer, Vice-President, has plans well in hand for what promises to be another very interesting and instructive meeting.

Among the chief events in the programme are the following:—

Autumn Lecture at 7.30 p.m. on Monday, September 3, in the Great Hall of the College of Technology. The lecture will be delivered by Dr. J. L. Haughton and will deal with the work of the late Dr. Walter Rosenhain, F.Inst.Met., F.R.S.

All-day excursion on Thursday to Froghall, North Staffordshire, visiting in the afternoon (by kind permission) the works of Messrs. Thomas Bolton & Sons, Limited.

Works Visits

The following firms have kindly promised to allow members (*except in some cases members in competitive occupations*) to visit their works:—

The Broughton Copper Company, Limited.
The British Copper Refiners, Limited, and British Insulated Cables, Limited (combined visit to both works).
Mather & Platt, Limited.
W. T. Glover & Company, Limited.
Callenders Cable & Construction Company, Limited.
Metropolitan-Vickers Electrical Company, Limited.
British Cotton Industry Research Laboratory.
The Chloride Electrical Storage Company, Limited.

Papers

The following is a complete list of the Papers that have been offered for the Autumn Meeting:—

"The Corrosion of Tin and its Alloys. Part I.—The Tin-Rich Tin-Antimony-Copper Alloys," by T. P. Hoar, M.A., Ph.D.

"Some (Magnetic) Properties of Heavily Cold-Worked Nickel," by H. Quinney, M.A.

"The Influence of Pickling on the Fatigue-Strength of Duralumin," by H. Sutton, M.Sc., and W. J. Taylor.

"A Reflectivity Method for Measuring the Tarnishing of Highly-Polished Metals," by L. Kenworthy, M.Sc., A.R.C.S., and J. M. Waldram, B.Sc., A.C.G.I.

"Experiments in Wire Drawing. Part IV.—Annealing of H.-C. Copper Wires of Varying Hardness—Elongation Values," by W. E. Alkins, M.Sc., and W. Cartwright, O.B.E., M.Sc.

"Crystal Re-Orientation on Heating Drawn Copper Wires," by G. S. Farnham, B.A., M.Sc., and Hugh O'Neill, M.Met., D.Sc.

"The Crystal Densities of Industrial Brasses from X-Ray Data," by Prof. E. A. Owen, M.A., D.Sc., and Llewelyn Pickup, M.Sc., Ph.D.

"The Improvement of White Bearing Metals for Severe Service: Some General Considerations," by D. J. Macnaughtan.

"The Behaviour of White Bearing Metals when Subjected to Various Deformation Tests. Part I.—Indentation Tests." With an Appendix on "An X-Ray Examination of Babbitt Metal and of the Age-Hardening of Cast Lead-Alkali Alloy," by A. S. Kenneford, M.Sc., and Hugh O'Neill, D.Sc., M.Met.

"The Behaviour of White Bearing Metals when Subjected to Various Deformation Tests. Part II.—Tensile Tests," by R. Arrowsmith, B.Met., M.Sc.

"The Behaviour of White Bearing Metals when Subjected to Various Deformation Tests. Part III.—Pounding Tests," by H. Greenwood, M.Sc.

"Some Properties of Tin Containing Small Amounts of Silver, Iron, Nickel or Copper," by Prof. D. Hanson, D.Sc., E. J. Sandford, B.Sc., and H. Stevens, M.Sc.

"Elongation Values of Copper and Copper-Rich Alloys," by Maurice Cook, M.Sc., Ph.D., and Eustace C. Larke.

"Deformation Lines in Alpha Brass," by Carl H. Samans, Ch.E., M.S.

"The Spectrographic Detection and Estimation of Minute Quantities of Impurities in Copper," by M. Milbourn, B.Sc.

"The Spectrographic Analysis of Some Alloys of Aluminium," by Ernest H. S. van Someren, B.Sc.

"A Synthetic Spectrum Method of Analysis and its Applications to the Quantitative Estimation of Small Quantities of Bismuth in Copper," by D. M. Smith, A.R.C.S., B.Sc.

"A Note on Some Ancient Copper-Coated Silver Coins of Cyprus," by Stanley G. Willimott, B.Sc., Ph.D.

The full particulars of the meeting are obtainable from Mr. G. Shaw Scott, the secretary, at 36, Victoria Street, London, S.W.

Thermal and Electrical Conductivity of Metals and Alloys

Materials are now being extensively employed in many branches of engineering practice at very high working temperatures, and a knowledge of the thermal and electrical conductivity of metals and alloys up to high temperatures is of practical importance as well as of theoretical interest. Attention has recently been devoted to this subject at the National Physical Laboratory, Teddington, and a Paper by Mr. R. W. Powell, B.Sc., of the Laboratory staff, dealing with the thermal and electrical conductivity of iron over the temperature range 0 deg. C. to 800 deg. C. was read before the Physical Society recently.

The thermal conductivity of Armco iron, containing approximately 99.92 per cent. iron, has been determined by means of a longitudinal-flow method over the range 30 deg. C. to 800 deg. C. During these experiments measurements were also made of the electrical resistance of the specimen. The thermal conductivity was found to decrease with increase in temperature, the values 0.177 c.g.s. unit at 0 deg. C. and 0.071 c.g.s. unit at 800 deg. C. being found. The value 0.177 is higher than that usually assumed for the thermal conductivity of iron, but a chemically prepared specimen of iron of greater purity has also been examined and was found to have a conductivity of 0.194 c.g.s. unit at 0 deg. C. It seems evident that the lower results obtained by earlier investigators were largely due to the relative impurity of their specimens. The electrical resistance of Armco iron was found to increase from 9.6×10^{-6} ohm. cm. at 0 deg. C. to 105.5×10^{-6} ohm. cm. at 800 deg. C. The value of the Lorenz function [thermal conductivity/(electrical conductivity × absolute temperature)] increases from 0.62×10^{-8} at 0 deg. C. to 0.74×10^{-8} at 400 deg. C., and remains approximately constant over the range 400 deg. to 700 deg. C. The standardised rods of Armco iron have since been used for the determination of the thermal conductivity of several heat-resistant metals by means of a comparative method, and the results of this work will shortly be published.

A STEEL-ROLLING MILL with auxiliary equipment which was shipped to Durban last week represented one of the largest orders completed in Sheffield for iron and steel works plant and machinery since pre-war days. The makers are Messrs. Davy Bros., Limited.

Setback in Spelter

By "ONLOOKER."

Spelter has recently distinguished itself by falling to the lowest level reached for something like eighteen months, and although some measure of recovery has been achieved, the outlook is far from promising. With a premium over lead of nearly £5 for a time, and latterly of about £4, the spelter situation has for months looked rather dubious, and even now the spread of £3 between these two metals is quite enough. The statistical position has kept fairly stable, but the cartel stocks at May 31 showed an increase of about 1,300 tons, which came at an inopportune moment, as the market was already disturbed by rumours of one kind and another. True, mid-June showed that stocks had been drawn upon to some extent, but with production ranging from 50 to 70 per cent. of capacity, it is useless to hope for much if any permanent improvement in the statistical position.

There seems to be little doubt that for a long time past sales of unwanted dutiable spelter on the London Metal Exchange have depressed the market unduly, this pressure coming not only from the Continent but also from Mexico, from which country British consumers have in the past taken quite a big tonnage. Recently, 2,000 tons of Mexican metal was sold on the market, and so the stocks of dutiable spelter in bonded warehouses are increased month by month. Some day it is possible that the value of zinc will improve sufficiently to permit of these stocks being shipped abroad for use in a country which does not tax raw materials, but at the present level this is out of the question, and no appreciable rise in spelter can be visualised in the near future.

If the Zinc Cartel is to go on, and it is more or less an open secret that its fate hangs in the balance at the present time, Germany is hardly likely to be a participant, for the Government there is determined to discourage imports and to do everything possible to speed up the output from native ores. To this end the zinc plant at Magdeburg is getting under way and will operate at the rate of 40,000 tons per annum, a tonnage sufficient to take care of about one-third of the country's needs. Last year Germany produced between 50,000 and 60,000 tons of spelter, so that with the Magdeburg electrolytic output in addition, the problem of dependence upon foreign countries will be well on the way to solution. Hitherto Canada and Australia have exported large quantities of zinc to Germany, and the closing of that market will be a serious blow to these two countries.

Since the price of spelter fell below £14 demand has revived, and the scarcity of prompt duty-free Empire metal has been clearly revealed. This day-to-day business in Canadian and Australian zinc does not, of course, touch the metal exchange, and the revival of consumptive buying by the brass makers and galvanisers has not, therefore, benefited the quotation on the London market at all. The contango or carrying rate is 7s. 6d. per ton, equal to about 10 per cent. per annum, and therefore unduly onerous, especially when one considers that, with spot metal available for consumption so scarce, the market *ought* to be registering a backwardation.

For the Empire producers the position is certainly not a happy one, for, owing to the obligation to look after consumers in this country imposed on them by the Ottawa agreements, they have been compelled to increase output beyond their cartel quotas, and therefore to pay fines. This would be bearable were prices favourable, but at the ruling level, and particularly when dealing with countries still on the gold standard, their net return is a poor one. Most people now agree that without the duty spelter would stand higher, but for better or for worse we have embarked upon a protectionist policy and must abide by the consequences.

This Week's News in Brief

Trade Talk

MR. J. M. PRIMROSE, Gadsden, Camelon, Falkirk, has obtained patent rights for his invention of a foundry moulding machine of the stripping-plate type.

THE CHINESE GOVERNMENT PURCHASING COMMISSION have awarded a share of the contract for 30,000 steel rails for the Canton-Hankow Railway to Messrs. Colvilles, Limited, Motherwell.

AGAINST STRONG foreign competition, the Harland Engineering Company, Limited, Alloa, have secured a contract for pumping plant for the Riga municipal waterworks, including three electrically-operated large pumping sets.

MESSRS. A. & J. MAIN, LIMITED, Clydesdale Ironworks, Possilpark, Glasgow, have secured the contract for the construction of large farm buildings near Dundee for the Public Health Committee of Dundee Town Council.

MESSRS. HURST, NELSON & COMPANY, LIMITED, Flemington, Motherwell, have just delivered to the Edinburgh Corporation a new type of tram body, which will be put into service next week. The tram is streamlined from roof to rail, and is built entirely of metal, rustless steel and an aluminium alloy.

MESSRS. ARDROSSAN DOCKYARD, LIMITED, launched the motor coaster "Carrick," built for British owners. The vessel, of the raised-quarter-deck type, is 150 ft. in length, and will have a carrying capacity of 450 tons of cargo. Her engines are of the Atlas-Diesel type, designed to give a speed of 10 knots.

CONSTANT EXPERIMENTS are finding new and extraordinary uses for wool, and perhaps the most remarkable use to which it has been put is as a driving pinion for an 18-ton excavator which has now been in use for more than two years. The cogs and body of the pinion are made entirely of wool, which, by a process of hardening, has been given the appearance of vulcanite.

THE FAIRFIELD SHIPBUILDING & ENGINEERING COMPANY, LIMITED, Govan, Glasgow, have received an order from Messrs. Bibby Line to build a passenger and cargo twin-screw motorship. The vessel will be 500 ft. in length, 66-ft. beam, and a gross tonnage of 13,000. The machinery will consist of Fairfield-Sulzer direct-injection two-stroke Diesel engines, and the vessel will be electrically operated throughout.

THE OPERATION of the 8-hr. day in the ironworks department of Messrs. Colvilles, Limited, Motherwell, is to be discussed at a conference arranged by the Iron and Steel Trades Confederation next week. The works have recently been mechanised, and the employees claim that instead of a 9½-hr. day they should be allowed to work the 8-hr. day which is general in industry. The firm have conceded the principle, but claim that a period would be required for the changeover. It is probable that the change will be put into operation after the annual Fair holidays, which commence on July 14.

THE MOTOR COASTING VESSEL "Atlantic Coast," which was launched by Messrs. Henry Robb, Limited, in May, has carried out successful trials on the Firth of Forth. The vessel is 230 ft. long, with a deadweight carrying capacity of 1,400 tons, with a draft at full load of less than 14 ft. The feature of the vessel is the shallow draft which will allow her to enter many of the British ports where formerly a ship of her size could not find way. The main engines built by British Auxiliaries, Limited, Glasgow, are of the Polar Diesel type, developing 1,250 h.p. on the twin screws. The mean speed on trials was 13.25 knots.

IMPROVED TRADE in the Motherwell district gives promise of a brighter Fair holiday for many of the local workers, and it is expected that in many cases the period will be curtailed for workmen in the heavy industries. Dalzell Steelworks, the largest in Motherwell, have ten furnaces in operation, compared with six a year ago, and some of the mills are well supplied with orders. A large order for special spring steel for Russia will keep the works going full time for several months after the holiday. The Lanarkshire Steel Company has also shared in the revival in the steel industry, and is well employed. Messrs. Anderson, Boyes, Limited, manufacturers of mining machinery, are very busy, and the staff will have to be content with a short holiday. The Clyde Alloy Steel Company, Limited, have large orders for special steels and castings necessitating overtime in many departments. The works are being extended and increasing numbers of workers are being taken on.

IN 1834 CHARLES RANDOLF and Richard S. Cunliff started a factory in Centre Street, Glasgow, for the production of small engines for driving machinery. This was the beginning of developments which were to lead to the establishment of one of the greatest shipbuilding yards on the Clyde—"Fairfield." In 1852 the famous John Elder joined the business, and as the designer and producer of the compound steam engine he laid the foundations of "Fairfield's" subsequent progress in marine work, and in so doing materially advanced the prestige of the shipbuilding and engineering industries of Clydeside. Elder has been succeeded by a number of other notable men, including Dr. Kirk, the designer of the first triple-expansion engine; Dr. Elgar, the famous naval architect; a well-known marine engineer in Sir Alexander Gracie; and Sir Alexander M. Kennedy, the present chairman of the company. It is, therefore, appropriate that at the moment the "Fairfield" yard should be busier than it has been for many years and one of the busiest on the river.

Company Reports

Hammond Lane Foundry Company, Limited.—Interim dividend of 5 per cent. on the ordinary shares.

Thomas Robinson & Son, Limited.—The directors have decided to pay the dividend on the 7½ per cent. cumulative preference shares for the half-year to December 31, 1932.

Ward & Goldstone, Limited.—Net profit, £14,239; brought in, £23,140; ordinary dividend for the year of 10 per cent.; carried forward, after meeting preference dividend, £28,179.

Belliss & Morcom, Limited.—Net profit, after depreciation, £8,284; preference dividend for year, £4,809; final dividend on the ordinary shares of 5 per cent., making 10 per cent., tax free.

Contracts Open

Ballygally.—285 yds. 3-in. cast-iron pipe, for the Larne Rural District Council. Mr. S. Robinson, Victoria Street, Larne.

Burnhope.—250 tons cast-iron pipes and specials, chiefly 40 in. diameter, for the Durham County Water Board. Resident Engineer, Burnhope Reservoir, Wearhead, Co. Durham.

Belfast, August 4.—30,000-kw. turbo-alternator and step-up transformers (specification No. W.165), for the Town Council. City Electrical Engineer, East Bridge Street, Belfast. (Fee £5 5s., returnable.)

Birkenhead, July 16.—2½ miles of steel or cast-iron pipes, principally 30 in. or 31 in. in diameter, with special pipes and castings, for the Town Council. Mr. R. F. Baker, water engineer, 601, Borough Road, Birkenhead. (Fee £2 2s., returnable.)

New Companies

(From the Register compiled by Jordan & Sons, Limited, Company Registration Agents, 116 to 118, Chancery Lane, London, W.C.2.)

France & Brook (Ironfounders), Limited, Crimble, Slaithwaite.—Capital £5,000.

Wincobank Rolling Mills Company, Limited, Wincobank Rolling Mills, Alsing Road, Wincobank, Sheffield.—Capital £3,000. Rolling-mill proprietors. Directors: A. Crookes and J. H. Crookes.

Triphase Furnace Company, Limited.—Capital £500. Manufacturers of and dealers in burners for gas, electrical or other industrial furnaces. Director: E. H. Steck, 214, Barnsley Road, Sheffield.

Felco Hoists, Limited, 17, Victoria Street, Westminster, S.W.1.—Capital £100. To take over that part of the business of Foundry Equipment, Limited, which consists of the manufacture and sale of chain pulley blocks, hoists and lifting apparatus, etc. Directors: J. B. Corrie, A. G. Corrie, A. S. Beech and L. J. Tichely.

Personal

SIR HAROLD E. YARROW, BT., C.B.E., managing director and chairman of Messrs. Yarrow & Company, Limited, Scotstoun, Glasgow, has been elected a director of the Clydesdale Bank.

MR. T. E. HASLAM, secretary, and MR. A. WOSTENHOLM, assistant secretary, have between them 100 years' service with the Sheepbridge Coal & Iron Company, Limited, and its associated concerns. After 52 years' service, Mr. Wostenholm is retiring, and on Friday last, at a gathering of 170 members of the staff, he was made the recipient of a number of presentations.

LIEUT.-COL. HUGH M. STOBART, C.B.E., D.S.O., vice-chairman of the North Eastern Marine Engineering Company, Limited, Wallsend-on-Tyne and Sunderland, has been appointed to the chairmanship, rendered vacant by the recent death of Mr. H. R. Murray-Philipson, M.P. Mr. O. J. Philipson, brother of the late chairman, has been appointed vice-chairman in succession to Colonel Stobart.

MR. J. G. GOODENOUGH, chief engineer of Messrs. Dorman, Long & Company, Limited, has been appointed assistant to the managing director of that company, and he will take up his new duties immediately. Mr. Goodenough will also continue to act as chief engineer. After demobilisation from the Air Force in April, 1919, Mr. Goodenough took up engineering work, and after taking a special degree course in engineering and chemistry at Cambridge, he joined, in 1921, Messrs. Ricardo & Company (Engineers), Limited, of Shoreham, experimental and consulting engineers in internal-combustion engine work. Following experience in South Africa, and also at the works of Messrs. J. & F. Howard, Limited, of Bedford, he was for five years with Messrs. Peter Brotherhood, Limited, engineers and ironfounders, Peterborough, as assistant to the works manager, and later also as assistant to the managing director of that firm. In 1929 he became manager of the experimental department of Messrs. John I. Thornycroft & Company, Limited, Southampton, and in 1932 entered the Central Engineering Department of Dorman, Long & Company, Limited, Middlesbrough.

Wills

GRAHAM, ARCHIBALD, engineer, Sutherland Avenue, Glasgow	£17,002
ALLAN, ROBERT, retired sheet-metal worker, Devanha Gardens, Aberdeen	£20,585
WOOD, W. W., senior partner of the Wardsend Steel Company, Sheffield	£75,791
MUSPRATT, SIR MAX., BT., of Liverpool, a director of Imperial Chemical Industries, Limited	£197,508
KENNARD, CAPT. M. A., R.N. (retired), of Bampton, Devon, chairman of the Falkirk Iron Company, Limited, and a director of Allied Ironfounders, Limited	£56,409

Obituary

MR. DAVID JAMES, who died recently, aged 77, was an official at the Baglan Engineering Works for many years, having retired last November.

MR. CHARLES WILLIAM TONKS, managing director of Messrs. E. Tonks & Sons, Limited, lock manufacturers and brassfounders, of Willenhall, died on June 28, aged 77 years.

THE ENGINEERING PROFESSION in Aberdeen has lost one of its most prominent members by the death of Mr. David Milne, on June 29, at his home in King Street. He was head of the firm of D. Milne & Sons, Limited. After serving his apprenticeship with Messrs. Hall, Russell & Company, Limited, Mr. Milne went to sea and later established an engineering business in America. Ill-health compelled him to return to his native country some years ago, and he joined his father in the business of D. Milne & Sons, which was founded 150 years ago by Mr. Milne's grandfather, the inventor of the sewing machine.

New Furnace Refractory.

In "Feuerungstechnik," E. REITLER describes the results of experimental work on a new refractory for basic and electric steelmaking furnaces. This refractory has a similar composition to standard silicate refractories, but contains more tridymite, and has a higher refractoriness. It can withstand pressures more effectively and possesses a lower relative expansion.

XUM

Raw Material Markets

The domestic consumption of iron and steel has been temporarily reduced by the district holidays now taking place in many parts of the country. It is not surprising, therefore, that current business is very dull. On the other hand, it is doubtful whether there is any foundation for the reports that industrial activity is beginning to slow down again after the spurt of the past twelve months. The blast furnaces and steelworks have plenty of work on hand, and the outlook ahead is reasonably good.

Pig-Iron

MIDDLESBROUGH.—As Cleveland ironmasters are now producing rather more material than is needed for home use, owing to holiday interruptions in the consuming trades, efforts have been made to find export outlets for the surplus, but with little success. The disturbed political and economic conditions abroad make it extremely difficult to get a foothold in foreign markets. However, any stocks of unsold iron which may arise in this district should be speedily absorbed by the autumn demand. The minimum home price of No. 3 Cleveland G.M.B., delivered Middlesbrough, remains at 67s. 6d. per ton.

East Coast hematite remains in strong demand under contract, but new business is far from brisk, and the makers would welcome more forward buying. Quotations continue at 68s. per ton for No. 1 hematite, delivered Middlesbrough, with extras for delivery to other areas. Mixed numbers, in all cases, are 6d. per ton cheaper than No. 1 grade.

LANCASHIRE.—There is no change in the consumption of pig-iron in this district. Conditions vary from one trade to another, of course, but generally the blast furnaces despatching iron to Lancashire report a satisfactory flow of specifications. The general price position remains steady, with offers of Derbyshire, Staffordshire and North-East Coast brands of No. 3 foundry quoted for delivery to Lancashire consumers on the basis of 74s. per ton, Northamptonshire at 72s. 6d., Lancashire pig-iron equal to Derbyshire quality at 74s. and equal to Northants at 72s. 6d. The demand for Scottish foundry iron in this area is slow, but at about 82s. 6d. per ton, delivered equal to Manchester, values are maintained.

MIDLANDS.—Ironfounders in the Midlands, particularly those engaged on light-castings work, remain very active, and many have well-filled order-books for the autumn. So far, however, there has not been much forward buying of pig-iron, although it seems that there is little to be gained by waiting. The current prices for Midland brands of iron, which include delivery to Birmingham and Black Country stations, are 67s. 6d. per ton for No. 3 Northants and 71s. per ton for Derbyshire, Lincolnshire and Staffordshire No. 3, subject to a small rebate for big consumers. With regard to engineering irons, the demand for which does not show any expansion, Scottish No. 3 is offered at between 85s. and 87s. 6d., and irons of a similar analysis from other districts at from 81s. to 85s. per ton. Where special refined iron is wanted for a particular class of work prices of £5 10s. to £6 15s. are being asked.

SCOTLAND.—Owing to holidays in Falkirk and district and the approach of the Fair holidays, the Glasgow pig-iron market was very subdued and business intermittent, only immediate requirements being covered. It is not likely that these conditions will alter much throughout the month. There is no change in the price of Scottish iron, which remains at the official minimum of 70s. for No. 3 foundry, f.o.t. furnaces, with 2s. 6d. per ton extra for No. 1. Shipments of Cleveland iron have been suspended on account of holidays, and there is no change to record in prices, which remain at 67s. 3d. f.o.t. Falkirk and 70s. 3d. f.o.t. Glasgow for No. 3 foundry. Other English foundry irons are quoted about 1s. per ton less. The general tone of the market has been rather uncertain, but, if anything, a slightly better view is being taken now.

Coke

Quotations for foundry coke are very firm, and there is every indication that higher levels will be seen in the autumn. Current values for delivery in South Staffs are as follow:—Best Durham coke, 36s. to 40s.; Welsh, 37s. 6d. to 45s. per ton.

Steel

The holiday conditions ruling have affected the volume of business, states the official report of the London Iron and Steel Exchange. Nevertheless, the tone of the market remains firm in practically all departments, and in the case of some descriptions of steel prices show a tendency to advance. In the semi-finished steel department most of the large consumers appear to be well covered, and the smaller buyers are content to purchase on hand-to-mouth lines. Although Continental material is quoted at low prices, the amount of business going abroad has not been important. Rather irregular conditions rule in the market for finished steel, and while some of the works are well employed, others are finding conditions difficult. The inquiry on export account has improved lately and orders have been taken for a number of oversea markets. The home trade demand has declined; but the works are well off for orders and confidence is felt that there will be the usual revival after the holiday season.

Scrap

The demand for scrap iron has been affected by the usual holiday influences, but there has been no serious decline in values. In the Cleveland area, heavy cast iron is at 50s. and machinery metal at 53s. 6d., business being limited. There continues to be a steady demand for cast-iron scrap in the Midlands at unchanged prices. In South Wales, heavy cast iron is weaker at 47s. 6d., whilst light cast-iron scrap is in lessened demand at 42s. 6d.; small sales of machinery scrap are made at about 50s. to 52s. 6d. There has been little demand for cast-iron scrap in Scotland, machinery metal being quoted at 55s., and ordinary cast-iron scrap, in pieces not exceeding 1 cwt., at 51s. 3d. to 52s. 6d.

Metals

Copper.—Following a partial withdrawal of selling pressure by American producers, copper prices on the London market showed a slightly firmer tone, but even so are still at a very low level. The European demand for copper remains only moderate, and the future price of this metal will be affected to a large extent by the development, favourable or otherwise, of the German situation. The announcement by the new Reich Raw Material Commissioner, that it would be his policy to further curtail German imports of non-ferrous metals, is very unpromising.

Daily quotations:—

Cash.—Thursday, £30 15s. to £30 17s. 6d.; Friday, £30 15s. to £30 16s. 3d.; Monday, £30 10s. to £30 11s. 3d.; Tuesday, £29 12s. 6d. to £29 13s. 9d.; Wednesday, £29 13s. 9d. to £29 15s.

Three Months.—Thursday, £31 3s. 9d. to £31 6s. 3d.; Friday, £31 1s. 3d. to £31 2s. 6d.; Monday, £30 16s. 3d. to £30 17s. 6d.; Tuesday, £30 to £30 1s. 3d.; Wednesday, £30 1s. 3d. to £30 2s. 6d.

Tin.—A limited business with consumers continues to be done in this metal, but reports from Europe and the United States indicate a falling off in the industrial demand. The London market has been dominated by "pool" operations during the past week. Buying of this character was responsible for last week's higher values, but the actual position was not strong enough to enable the advance to be sustained.

Market prices:—

Cash.—Thursday, £232 to £232 5s.; Friday, £230 5s. to £230 10s.; Monday, £230 10s. to £230 12s. 6d.; Tuesday, £230 5s. to £230 10s.; Wednesday, £230 15s. to £231.

Three Months. — Thursday, £231 5s. to £231 7s. 6d.; Friday, £229 10s. to £229 15s.; Monday, £229 10s. to £229 15s.; Tuesday, £229 10s. to £229 15s.; Wednesday, £229 15s. to £229 17s. 6d.

Spelter.—The market has been steady and the shortage of Empire metal in this country has continued. Stocks of duty-free metal of foreign origin are now at a very low ebb, and there is no possibility of supplementing the stocks available for consumers in this country except by importing bonded metal and paying the duty. "That the Government should have intended foreign metal to come in in this way is doubtful, as it was expected that the duty would only keep the market open for Empire metal. This illustrates once again that a tariff frequently has an effect which is contrary to what was intended," state Messrs. Brandeis, Goldschmidt in their weekly report.

Day-by-day prices:—

Ordinary.—Thursday, £13 18s. 9d.; Friday, £13 15s.; Monday, £13 11s. 3d.; Tuesday, £13 6s. 3d.; Wednesday, £13 8s. 9d.

Lead.—There continues to be a good demand for lead from industrial consumers. Plentiful supplies are available, and there is little prospect of higher prices ruling, at least for some time.

Market fluctuations:—

Soft Foreign (Prompt).—Thursday, £10 16s. 3d.; Friday, £10 15s.; Monday, £10 15s.; Tuesday, £10 13s. 9d.; Wednesday, £10 17s. 6d.

Iron and Steel Production

The British Iron and Steel Federation, in its "Statistical Bulletin" for May, states that output of pig-iron and steel in the United Kingdom is still maintained at a relatively high level, pig-iron production increasing from 496,300 tons in April to 527,900 tons in May, an increase, taking into account the extra working day, of 3 per cent. Furnaces in blast increased by three during the month to 101, which is the first time that the number of 100 has been exceeded since September, 1930. Steel production rose from 716,800 tons in April to 780,000 tons in May.

GENERAL REFRACTORIES, LIMITED, has acquired control of the old-established silica-brick business of Messrs. N. B. Allen & Company, Limited, Hirwaun, Glamorgan.

CAST IRON FLANGED PIPES
2 in.–12 in. & CONNECTIONS. to 24 in. dia.
WE HAVE FIFTY-TWO YEARS OF ACCUMULATED EXPERIENCE AND METAL PATTERNS.
JAMES & RONALD RITCHIE, LTD.,
Telephone: 3852 (2 Lines). MIDDLESBROUGH. Telegrams: "Ritchie, Middlesbrough."

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"VOLCLAY" BENTONITE

Used in 80% to 90% of the Iron and Steel Foundries in U.S.A.—and *considered practically indispensable*

Its use is increasing in moulding sands because

1. A much smaller proportion of clay substance is mixed with the sand than when fire clay or natural moulding sand is used. Approximately only 2—3% is necessary.
2. The sand is more open because it contains less clay substance. Finer sands can therefore be used, and the same permeability maintained.
3. By using a small proportion of high bond clay such as "VOLCLAY" there is less "dead" clay to accumulate in the sand.
4. "VOLCLAY" retains its bonding properties under heating and re-heating longer than fire clays and natural moulding sands.
5. "VOLCLAY"-bonded sands require less moisture for tempering and the dry bond strength of "VOLCLAY" is particularly high.
6. The fusion point is higher than natural moulding sand and equal to that of sand bonded with fire clay.

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Distributing Agents to the Foundry Trade for

THE FREDK. CRANE CHEMICAL COMPANY LIMITED

ARMOURY CLOSE, BORDESLEY GREEN, BIRMINGHAM

Telephone: Victoria 0416 (3 lines). *Manufacturers of 'CRANCO' Pattern Makers' Varnish — send for sample and quotation.* Telegrams: "Chemical" Birmingham.

RAW MATERIALS—PRICE LIST

(Wednesday, July 11, 1934)

COPPER

	£	s.	d.
Standard cash	29	13	9
Three months	30	1	3
Electrolytic	32	15	0
Tough	32	0	0
Best selected	32	0	0
Sheets	60	0	0
India	42	15	0
Wire bars	33	0	0
Ingot bars	33	0	0
H.C. wire rods	35	10	0
Off. av. cash, June	32	3	9
Do., 3 mths., June	32	10	5 5/16
Do., Sttlmnt., June	32	3	9 5/16
Do., Electro, June	35	10	7½
Do., B.S., June	35	3	7½
Do., wire bars, June	35	14	4½
Solid drawn tubes			10d.
Brazed tubes			10d.
Wire			6½d.

BRASS

Solid drawn tubes	9d.
Brazed tubes	11d.
Rods, drawn	8¾d.
Rods, extd. or rlld.	4½d.
Sheets to 10 w.g.	7¾d.
Wire	7¾d.
Rolled metal	6¾d.
Yellow metal rods	4½d.
Do. 4 × 4 Squares	5¾d.
Do. 4 × 3 Sheets	5¾d.

TIN

	£	s.	d.
Standard cash	230	15	0
Three months	229	15	0
English	231	2	6
Bars	232	15	0
Straits	231	7	6
Australian (nom.)			—
Eastern	229	10	0
Banca	232	5	0
Off. av. cash, June	226	19	9 2/7
Do., 3 mths., June	226	3	6 1/7
Do., Sttlmt., June	226	18	9 3/7

SPELTER

	£	s.	d.
Ordinary	13	8	9
Remelted	14	0	0
Hard	11	0	0
Electro 99.9	16	0	0
English	14	2	6
India	13	0	0
Zinc dust	16	10	0
Zinc ashes	3	0	0
Off. aver., June	14	7	1
Aver. spot, June	14	4	9 2/7

LEAD

	£	s.	d.
Soft foreign ppt.	10	17	6
Empire (nom.)	11	3	9
English	12	10	0
Off. average, June	11	3	0 1/14
Average spot, June	11	1	0 9/7

ALUMINIUM

Ingots	£100 to £105
Wire	1/1 to 1/9 lb.
Sheet and foil	1/2 to 2/9 lb.

ZINC SHEETS, &c.

	£	s.	d.
Zinc sheets, English	23	5	0
Do., V.M. ex whse.	21	15	0
Rods	27	10	0

ANTIMONY

	£	s.	d.	£	s.	d.
English	40	0	0 to	43	0	0
Chinese, ex-whse.				35	5	0
Crude				24	10	0

QUICKSILVER

	£	s.	d.	£	s.	d.
Quicksilver	11	0	0 to	11	10	0

FERRO-ALLOYS AND STEEL-MAKING METALS

Ferro-silicon—	
25%	8 17 6
45/50%	13 0 0
75%	18 7 6
Ferro-vanadium—	
35 50%	12/8 lb. Va.
Ferro-molybdenum—	
70/75% carbon-free of Mo.	5/6 per lb.
Ferro-titanium—	
23/25% carbon-free	9d. lb.
Ferro-phosphorus, 20/25%	£14 10 0
Ferro-tungsten—	
80/85%	3/3 lb.
Tungsten metal powder—	
98/99%	3/6 lb.
Ferro-chrome—	
2/4% car.	29 15 0
4/6% car.	23 0 0
6/8% car.	21 12 6
8/10% car.	21 12 6
Ferro-chrome—	
Max. 2% car.	36 0 0
Max. 1% car.	38 15 0
Max. 0.70% car.	42 0 0
70% carbon-free	10d. lb.
Nickel—99.5/100%	£200 to £205
"F" nickel shot	£184 0 0
Ferro-cobalt, 98/99%	5/3 lb.
Metallic chromium—	
96/98%	2/5 lb.
Ferro-manganese (net)—	
76/80% loose	£10 15 0 to £11 5 0
76/80% packed	£11 15 0 to £12 5 0
76/80% export	(nom.) £9 15 0
Metallic manganese—	
94/96% carbon-free	1/2 lb.

Per ton unless otherwise stated.

HIGH-SPEED TOOL STEEL

Finished bars, 14% tungsten	2s. 0d.
Finished bars, 18% tungsten	2s. 9d.

Per lb. net, d/d buyers' works.

Extras—	
Rounds and squares, 3 in. and over	4d. lb.
Rounds and squares, under ½ in. to ¼ in.	3d. lb.
Do., under ¼ in. to 7/32 in.	1/- lb.
Flats, ½ in. × ¼ in. to under 1 in. × ½ in.	3d. lb.
Do., under ¼ in. × ¼ in.	1/- lb.
Bevels of approved sizes and sections	6d. lb.

Bars cut to length, 10% extra.

SCRAP

	£	s.	d.	£	s.	d.
South Wales—						
Heavy steel	2	14	0 to	2	15	0
Bundled steel and shrngs.				2	7	6
Mixed iron and steel				2	10	0
Heavy cast iron				2	7	6
Good machinery	2	10	0 to	2	12	6
Cleveland—						
Heavy steel	2	7	6 to	2	10	0
Steel turnings				1	17	6
Cast-iron borings				1	7	6
Heavy forge				2	10	0
W.I. piling scrap				2	5	0
Cast-iron scrap	2	10	0 to	2	13	6
Midlands—						
Light cast-iron scrap				2	7	6
Heavy wrought iron				3	0	0
Steel turnings, f.o.r.				1	13	0
Scotland—						
Heavy steel	2	10	0 to	2	11	3
Ordinary cast iron	2	11	3 to	2	12	6
Engineers' turnings				1	19	6
Cast-iron borings				2	0	0
Wrought-iron piling	2	10	0 to	2	11	3
Heavy machinery				2	15	0

London—Merchants' buying prices, delivered yard.

	£	s.	d.
Copper (clean)	25	0	0
Brass	18	0	0
Lead (less usual draft)	10	0	0
Tea lead	7	5	0
Zinc	9	0	0
New aluminium cuttings	69	0	0
Braziery copper	22	0	0
Gunmetal	23	10	0
Hollow pewter	145	0	0
Shaped black pewter	110	0	0

PIG-IRON

N.E. Coast (d/d Tees-side area)—	
Foundry No. 1	70/-
Foundry No. 3	67/6
,, at Falkirk	67/3
,, at Glasgow	70/3
Foundry No. 4	66/6
Forge No. 4	66/6
Hematite No. 1	68/-
Hematite M/Nos.	67/6
N.W. Coast—	
Hem. M/Nos. d/d Glas.	72/6
,, d/d Birm.	84/6
Malleable iron d/d Birm.	115/-
Midlands (d/d Birmingham dist.)—	
Staffs No. 4 forge	67/-
,, No. 3 fdry.	71/-
Northants forge	63/6
,, fdry. No. 3	67/6
,, fdry. No. 1	70/6
Derbyshire forge	67/-
,, fdry. No. 3	71/-
,, fdry. No. 1	74/-
Scotland—	
Foundry No. 1, f.o.t.	72/6
,, No. 3, f.o.t.	70/-
Hem. M/Nos. d/d	71/-
Sheffield (d/d district)—	
Derby forge	64/6
,, fdry. No. 3	68/6
Lincs forge	64/6
,, fdry. No. 3	68/6
E.C. hematite	80/6
W.C. hematite	83/6
Lancashire (d/d eq. Man.)—	
Derby fdry. No. 3	74/-
Staffs fdry. No. 3	74/-
Northants fdry. No. 3	72/6
Cleveland fdry. No. 3	74/-
Dalzell, No. 3 (special)	102/6 to 105/-
Glengarnock, No. 3	82/6
Clyde, No. 3	82/6
Monkland, No. 3	82/6
Summerlee, No. 3	82/6
Eglinton, No. 3	82/6
Gartsherrie, No. 3	82/6
Shotts, No. 3	82/6

FINISHED IRON AND STEEL

Usual district deliveries for iron; delivered consumer's station for steel.

Iron—	£	s.	d.	£	s.	d.
Bars (cr.)	9	12	6 to	9	15	0
Nut and bolt iron	7	10	0 to	8	0	0
Hoops	10	10	0 and up.			
Marked bars (Staffs) f.o.t.	12	0	0			
Gas strip	10	10	0 and up.			
Bolts and nuts, ¼ in. × 4 in.	14	0	0			
Steel—						
Plates, ship, etc.	8	15	0 to	8	17	6
Boiler plts.	8	2	6 to	8	10	0
Chequer plts.	10	7	6			
Angles	8	7	6			
Tees	9	7	6			
Joists	8	15	0			
Rounds and squares, 3 in. to 5½ in.	9	7	6			
Rounds under 3 in. to ¾ in. (Untested)	8	12	0			
Flats—8 in. wide and over	8	12	6			
,, under 8 in. and over 5 in.	8	17	6			
Rails, heavy	8	5	0 to	8	10	0
Fishplates	12	5	0 to	12	10	0
Hoops (Staffs)	9	7	0			
Black sheets, 24g. (4-t. lots)	10	10	0			
Galv. cor. shts. (,,)	13	0	0			
Galv. flat shts. (,,)	13	10	0			
Galv. fencing wire, 8g. plain	14	10	0			
Billets, soft	5	10	0			
Billets, hard	6	17	6 to	7	2	6
Sheet bars	5	0	0 to	5	5	0
Tin bars	5	0	0			

PHOSPHOR BRONZE

	Per lb. basis.
Strip	11d.
Sheet to 10 w.g.	12d.
Wire	11½d.
Rods	11d.
Tubes	15d.
Castings	13d.

Delivery 3 cwt. free.
10% phos. cop. £30 above B.S.
15% phos. cop. £35 above B.S.
Phosphor tin (5%) £30 above price of English ingots.
C. CLIFFORD & SON, LIMITED.

NICKEL SILVER, &c.

	Per lb.
Ingots for raising	7d. to 1/1
Rolled—	
To 9 in. wide	1/1 to 1/7
To 12 in. wide	1/1½ to 1/7½
To 15 in. wide	1/1½ to 1/7½
To 18 in. wide	1/2 to 1/8
To 21 in. wide	1/2½ to 1/8½
To 25 in. wide	1/3 to 1/9
Ingots for spoons and forks	7d. to 1/3½
Ingots rolled to spoon size	10d. to 1/6½
Wire round—	
to 10g.	1/4½ to 1/11½

with extras according to gauge.
Special 5ths quality turning rods in straight lengths, 1/3½ upwards.

AMERICAN IRON AND STEEL

At Pittsburgh unless otherwise stated.

	Dols.
No. 2 foundry, Phila.	20.26
No. 2 foundry, Valley	18.50
No. 2 foundry, Birm.	14.50
Basic, Valley	18.00
Bessemer	20.76
Malleable, Valley	18.50
Grey forge, Valley	18.25
Ferro-mang. 80%, seaboard	85.00
O.-h. rails, h'y, at mill	36.37½
Billets	29.00
Sheet bars	30.00
Wire rods	38.00
	Cents.
Iron bars, Chicago	1.90
Steel bars	1.90
Tank plates	1.85
Beams, etc.	1.85
Skelp, grooved steel	1.70
Steel hoops	2.10
Sheets, black, No. 24	2.65
Sheets, galv., No. 24	3.25
Wire nails	2.60
Plain wire	2.30
Barbed wire, galv.	3.00
Tinplates, 100-lb. box	$5.25

COKE (at ovens)

Welsh foundry	25/- to 30/-
,, furnace	20/-
Durham foundry	21/- to 25/-
,, furnace	17/6
Midlands, foundry	—
,, furnace	—

TINPLATES

f.o.b. Bristol Channel ports.

I.C. cokes	20×14 per box	17/3 to 17/6
,,	28×20 ,,	34/6 to 35/-
,,	20×10 ,,	24/9 to 25/-
,,	18¾×14 ,,	18/- to 18/1½
C.W.	20×14 ,,	15/6
,,	28×20 ,,	32/6
,,	20×10 ,,	22/-
,,	18¾×14 ,,	15/6

SWEDISH CHARCOAL IRON & STEEL

	£	s.	d.	£	s.	d.
Pig-iron	£6	0	0 to	£7	0	0
Bars-hammered, basis	£16	0	0 to	£16	10	0
Bars and nail-rods, rolled, basis	£15	15	0 to	£16	0	0
Blooms	£10	0	0 to	£12	0	0
Keg steel	£30	0	0 to	£31	0	0
Faggot steel	£18	0	0 to	£23	0	0
Bars and rods dead soft, st'l	£10	0	0 to	£12	0	0

All per English ton, f.o.b. Gothenburg.
[Subject to an exchange basis of Kr. 18.16 to £1.]

DAILY FLUCTUATIONS

Standard Copper (cash)

		£	s.	d.		
July	5 ..	30	15	0	inc.	7/6
,,	6 ..	30	15	0	No change	
,,	9 ..	30	10	0	dec.	5/-
,,	10 ..	29	12	6	,,	17/6
,,	11 ..	29	13	9	inc.	1/3

Electrolytic Copper

		£	s.	d.		
July	5 ..	34	0	0	inc.	10/-
,,	6 ..	33	17	6	dec.	2/6
,,	9 ..	33	10	0	,,	7/6
,,	10 ..	32	10	0	,,	20/-
,,	11 ..	32	15	0	inc.	5/-

Standard Tin (cash)

		£	s.	d.		
July	5 ..	232	0	0	inc.	75/-
,,	6 ..	230	5	0	dec.	35/-
,,	9 ..	230	10	0	inc.	5/-
,,	10 ..	230	5	0	dec.	5/-
,,	11 ..	230	15	0	inc.	10/-

Tin (English ingots)

		£	s.	d.		
July	5 ..	232	7	6	inc.	82/6
,,	6 ..	230	12	6	dec.	35/-
,,	9 ..	231	0	0	inc.	7/6
,,	10 ..	230	12	6	dec.	7/6
,,	11 ..	231	2	6	inc.	10/-

Spelter (ordinary)

		£	s.	d.		
July	5 ..	13	18	9	inc.	1/3
,,	6 ..	13	15	0	dec.	3/9
,,	9 ..	13	11	3	,,	3/9
,,	10 ..	13	6	3	,,	5/-
,,	11 ..	13	8	9	inc.	2/6

Spelter (Electro, 99.9 per cent.)

		£	s.	d.		
July	5 ..	16	11	3	inc.	1/3
,,	6 ..	16	8	9	dec.	2/6
,,	9 ..	16	3	9	,,	5/-
,,	10 ..	16	0	0	,,	3/9
,,	11 ..	16	0	0	No change	

Zinc Sheets (English)

		£	s.	d.		
July	5 ..	23	5	0	No change	
,,	6 ..	23	5	0	,,	,,
,,	9 ..	23	5	0	,,	,,
,,	10 ..	23	5	0	,,	,,
,,	11 ..	23	5	0	,,	,,

Lead (English)

		£	s.	d.		
July	5 ..	12	10	0	No change	
,,	6 ..	12	10	0	,,	,,
,,	9 ..	12	10	0	,,	,,
,,	10 ..	12	10	0	,,	,,
,,	11 ..	12	10	0	,,	,,

AVERAGE MONTHLY PRICES OF CLEVELAND No. 3 PIG-IRON.

Year	Jan.	Feb.	March	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Yearly average
	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.	s. d.
1894	35 8	35 11	36 1	36 1	35 5	35 5	35 5	35 11	36 6	35 8	35 8	35 1	35 9
1895	34 7	34 4	34 4	34 8	35 6	35 2	36 1	37 1	38 10	38 6	37 11	37 6	36 3
1896	37 3	38 4	38 7	38 1	37 4	37 4	36 11	36 11	37 11	39 2	40 5	40 5	38 3
1897	41 2	40 4	40 5	39 2	39 7	40 9	39 6	40 5	41 7	42 5	41 5	40 4	40 7
1898	40 9	40 8	40 6	40 0	40 7	39 11	40 4	41 11	43 0	44 11	49 1	44 3	42 0
1899	46 10	47 11	47 9	49 10	55 11	62 10	71 6	65 9	67 7	68 8	70 0	66 9	60 5
1900	67 10	68 10	73 10	76 2	74 2	68 6	69 3	71 4	70 9	67 8	63 6	53 6	68 9
1901	48 0	46 6	45 8	45 5	45 10	44 7	44 6	45 3	45 3	45 3	43 6	43 1	45 3
1902	43 11	46 7	46 9	47 11	48 10	49 7	50 9	52 1	53 6	52 9	50 9	47 11	49 3
1903	47 3	48 9	51 10	49 0	46 1	46 2	46 7	46 8	45 7	43 6	42 10	41 11	46 4
1904	42 3	42 7	43 3	44 7	44 0	42 10	42 9	43 3	43 1	43 9	46 1	48 7	43 11
1905	48 11	48 0	49 6	50 1	51 5	45 6	45 9	47 5	48 8	52 11	52 9	53 3	49 6
1906	53 9	50 1	48 1	48 8	50 2	50 3	50 6	53 0	54 6	56 8	58 6	62 4	53 6
1907	60 4	56 6	54 10	56 0	61 1	58 1	57 8	57 8	55 7	54 8	50 8	50 0	56 2
1908	48 5	49 3	51 7	51 10	51 6	51 2	50 0	51 4	52 0	49 8	49 4	48 11	50 8
1909	48 10	48 1	46 9	47 9	48 4	48 9	48 6	50 5	51 3	51 11	51 2	50 7	49 4
1910	51 10	51 3½	51 7½	50 10	49 10	49 2	48 10	49 8½	49 3½	49 7½	49 6½	49 10	50 4
1911	49 11½	49 2½	48 5	46 11	46 4	46 6	46 11½	47 4	47 0	46 7	47 4½	48 1	47 7
1912	50 0	49 5½	51 1½	53 7½	54 4	55 1	57 5½	64 6½	61 7½	66 8½	67 8	68 0	58 5½
1913	66 11½	63 8½	64 8	67 1½	66 3	56 9½	56 3½	55 8	55 4	53 0	50 1	50 4	58 10
1914	50 11	51 5½	51 0½	51 4½	51 6	51 6½	51 5	52 3	51 5	50 1	50 3	53 0	51 4½
1915	55 7	56 6	61 0	66 7	65 2	66 10	65 4	66 0½	65 3	65 11	69 10½	75 7½	65 7
1916	80 2	91 6	87 4½	86 10	82 6	82 6	87 6	87 6	87 6	87 6	87 6	87 6	85 10
1917	87 6	87 6	87 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	92 6	95 0	99 3
1918	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0	95 0
1919	95 0	95 0	95 0	95 0	152 6	160 0	160 0	160 0	160 0	160 0	160 0	160 0	137 8
1920	175 0	175 0	187 6	200 0	208 0	217 6	217 6	221 0	225 0	225 0	225 0	225 0	209 3
1921	222 6	195 0	150 0	126 0	120 0	120 0	120 0	136 3	127 0	120 0	110 0	100 0	137 4
1922	92 6	90 0	90 0	90 0	90 0	90 0	89 0	87 3	92 6	92 6	92 6	91 3½	90 7½
1923	94 6	108 9	125 6	129 4½	128 5	136 0	128 1½	121 11	97 1½	97 0	100 0	100 0	110 6½
1924	99 10	97 3½	91 9	93 9	91 9	89 10½	87 9	85 0	82 5½	80 2½	81 9	81 9	88 7½
1925	80 4½	78 10½	78 0	78 3	76 0	73 10½	71 7½	69 10½	68 1½	66 7½	66 0	66 10½	72 10½
1926	69 4½	70 0	70 0	70 0	72 6	75 10½	86 7½	90 0	93 10½	117 10	120 0	99 0	86 3
1927	85 0	83 1½	81 0	80 0	73 9	70 0	70 0	68 9	67 6	67 6	66 10½	65 0	73 2½
1928	65 0	65 0	65 6	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	66 0	65 9½
1929	66 0	66 9	67 0	68 1½	69 5	71 10½	72 9	72 6	72 6	72 6	72 6	72 6	70 4½
1930	72 6	72 6	70 0	67 6	67 6	67 6	67 6	64 6	63 6	63 6	63 6	63 6	66 11½
1931	59 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 7
1932	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6	58 6
1933*	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6	62 6
1934*	62 6	65 0	67 6	67 6	67 6	67 6	—	—	—	—	—	—	—

* Delivered Middlesbrough area. Prior to 1933, prices were f.o.t. furnaces.

WILLIAM JACKS & COMPANY,
WINCHESTER HOUSE, OLD BROAD ST., LONDON, E.C.2.

CLARENCE CHAMBERS, 39, CORPORATION STREET, BIRMINGHAM.
13, RUMFORD STREET, LIVERPOOL.

PIG IRON

REGISTERED TRADE MARK
CLIMPET

All grades FOUNDRY, HEMATITE, BASIC, SPECIALS, &c.

NON-FERROUS METALS

COPPER, TIN, LEAD, SPELTER, ANTIMONY, CHROME ORE.

WILLIAM JACKS & COMPANY,
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ZETLAND ROAD, MIDDLESBROUGH.

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(A remittance should accompany instructions.)

SITUATIONS VACANT AND WANTED

WANTED, position as Manager or Agent for moulders' chaplet-manufacturing business. Over 30 years' practical experience with oldest-established firm.—Box 802, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

ASSISTANT Foundry Manager; young man, for small but growing foundry, mainly engaged on high-grade motor and engineering castings. Must have sound general foundry experience as well as modern repetition production methods of small and medium castings. Able to calculate full estimates from blue-prints. Freferably with some engineering training. State age, full details of experience and salary required.—Box 806, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

EMPLOYMENT REGISTER.

Conducted by the Institute of British Foundrymen by courtesy of the proprietors of THE FOUNDRY TRADE JOURNAL.

Correspondence should be addressed to the General Secretary, Institute of British Foundrymen, St. John Street Chambers, Deansgate, Manchester, from whom full particulars can be obtained of this service.

Any employer wishing to communicate with a candidate should write to the General Secretary, quoting identification number.

FOUNDRY Foreman desires position. Experienced in jobbing work, machine-moulding, estimating, cupola practice, etc. Will accept position as Working Foreman in small firm. (247)

JOBBING Foundry Manager open for re-engagement or as Foreman. Has had general control, costing, estimating, buying, cupola control and moulding, coremaking, etc. Excellent record. (248)

FOR SALE BY PRIVATE TREATY

By Direction of TRIPLEX FOUNDRY, LIMITED, GREAT BRIDGE, STAFFS, who are shortly removing to their New Foundry at Tipton.

FOR SALE BY PRIVATE TREATY, WITH POSSESSION ON COMPLETION,

The Substantially-built and Extensive FREEHOLD MANUFACTURING PREMISES,

Situate at Bridge Road and Toll End Road, GREAT BRIDGE, TIPTON, STAFFS,

COMPRISING A TOTAL AREA OF 20,900 SQUARE YARDS

with RUNWAYS and FIRST-CLASS MELTING PLANT.

There is a frontage to Canal Basin of about 1,000 ft. The distance from the L.M. & S. and G.W.R. Goods Stations at Great Bridge is ¼-mile, and services include South Staffs and Canal Water Supplies, Gas and Electric Light and Power.

First-class South Staffordshire labour is available in the district.

Further particulars and Permits to Inspect may be obtained from J. V. BOSWELL & COMPANY, F.A.I., Auctioneers and Valuers, 4, Waterloo Road, Wolverhampton (Telephone 21216/7), or MESSRS. CHESSHIRE, GIBSON & COMPANY, F.A.I., Auctioneers and Valuers, 21, Waterloo Street, Birmingham (Telephone Midland 6651/2).

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MAGNIFICENT
11 ACRES WORKS SITE.
SHEFFIELD.
145,000 Sq. Ft. of Shops.
SIDING CONNECTIONS
with L.M. & S. and L. & N.E. Rlys.
WELL-BUILT & COMMODIOUS OFFICES

Will Sell whole or in lots to suit customers or Let on favourable terms. Unique opportunity for Manufacturers.

Apply—
THOS. W. WARD, LTD.,
ALBION WORKS, SHEFFIELD

MACHINERY

GENUINE Whittaker Gear-wheel Moulding Machine, all change wheels, perfect. Price £40. Inspection at Slough.
A. HAMMOND, 14, Australia Road, Slough.
Also Crane Ladles, all sizes, in stock.

"KETIN" Sand-preparing Plant, capacity 3 tons per hour, direct motor-driven, 440 volts, 3 close, 40 cycles; Sifter, Mixer, Mill and Disintegrator; in first-class condition. —Apply, Box 804, Offices of THE FOUNDRY TRADE JOURNAL, 49, Wellington Street, Strand, London, W.C.2.

TILGHMAN'S SAND-BLAST PLANTS AND AIR COMPRESSORS

We always have in stock
SECONDHAND RE-CONDITIONED PLANTS and New Sand-blast Plants,
Also
RE-CONDITIONED AIR COMPRESSORS and New Compressors.
All Sizes—All Pressures.
We SHOT (or Sand) Blast for all Trades.

R. J. RICHARDSON & SONS, LTD.,
COMMERCIAL STREET, BIRMINGHAM, 1.

THOS. W. WARD LTD.

Steel Geared LADLES, RUMBLERS and MOULDING MACHINES.
3-cwt. "Massey" Pneu. POWER HAMMER, 17" str.
Auto. Plate Iron GRINDER, cap. 30" long, 60" bed.
VERT. COCHRAN L.T. BOILER, 16' 3" x 7' 6", 80 lbs. w.p.
Write for "Albion" Catalogue.
'Grams: "Forward." 'Phone: 23001 (10 lines).
ALBION WORKS, SHEFFIELD.

SANDBLAST PLANTS

Room, Rotary Barrel and Cabinet Types complete; 12 in stock.

SAND PLANT

Sand Mills, 6-ft., 5-ft. and 4-ft. 6-in. dia. Pans.
Rotoil "Senior" Oil Core Sand Mixer.
Pneulec Sand Drying Plant, output 1 ton per hour.
Brearley Type Disintegrators.

MOULDING MACHINES

Hand and Pneumatic Types.
Also
Six Rowlands Double-ended Grinders for 24-in. dia. x 2-in. wheels.
Electrical and Belt-driven Blowers and Exhaust Fans, Ladles, etc., etc.

AIR COMPRESSORS

All sizes for high and low pressures.

S. C. BILSBY, A.M.I.C.E., A.M.I.E.E.
CROSSWELLS ROAD (Adjoining Railway Crossing), LANGLEY, Nr. Birmingham.
'Phone: Broadwell 1359.

NOTICE

PRELIMINARY NOTICE is given that the entire Plant and Buildings of the old-established concern of Edward Stevenson, Limited, Nottingham, will be offered for Sale. Offers should be sent to MESSRS. STOKES & RICKS, Sherwood Buildings, Sherwood Street, Nottingham.

MISCELLANEOUS

FLUIDITY TESTS as described in THE FOUNDRY TRADE JOURNAL, February 1, 1934. Patterns of the above in aluminium can be supplied for 35s. per set. Post free. We can also supply Patterns for all branches of the engineering trade, in hard or soft woods. Send us your inquiries.—FURMSTON & LAWLOR, Patternmakers, Letchworth, Herts.

PUBLICATION

RYLAND'S DIRECTORY of the Coal, Iron, Steel, Tinplate, Metal, Engineering, Hardware and Allied Trades. 1934 edition. Price 42s. cloth bound, 52s. morocco. Order *YOUR* copy *NOW*.—INDUSTRIAL NEWSPAPERS, LIMITED, 49, Wellington Street, Strand, London, W.C.2.

'Phone: 287 SLOUGH

SANDBLAST PLANTS

12' × 9' Tilghman sandblast room, built of cast iron plates, complete with 400 cu. ft. Tilghman air compressor and all accessories £290 Nett.

T.B. 1 Tilghman sandblast barrel plant, complete. CHEAP.

T.B. 3 Tilghman sandblast barrel plant, double-jet, complete. CHEAP.

6' "Jackman" rotary sandblast table. CHEAP seen working.

SAND PLANT

Herbert "Whizzer" type disintegrator, No. 1 £30
Pneumatic riddle, by Macdonald £8
Large "Baillott" sand preparing plant CHEAP.

BUY FROM ME AND SAVE MONEY!

ALEX. HAMMOND, *Foundry Machinery Merchant,*
14, AUSTRALIA ROAD, SLOUGH

PETER—WITH ONE EXCEPTION

With one exception Peter is an ordinary little fellow. Chubby, likeable, just five-and-a-half, full of life and fun and on occasions—be it admitted—of naughtiness.

Just now Peter's rather important, for this is his first term at school, and he's grappling with the intricacies of "A B C" and "Twice-Two": difficult subjects to all men of five-and-a-half, but even more difficult in Peter's case because—bad luck—he's totally blind. That's his One Exception.

Peter learns reading, writing, and 'rithmetic through the medium of "Braille"—dull stuff compared with the coloured picture books of most five-and-a-halfs. However, he's a stout lad is Peter, and he's making great progress.

Would you like to know more about him? How, in spite of his "One Exception," he is being educated and, when older, technically trained and usefully employed.

There is a long waiting list of "Peters" throughout the British Isles, for whom training and accommodation must be provided in the immediate future.

Will you help with a donation or annual subscription? Any sum, large or small, will be gratefully received.

Here's a suggestion. Your eyesight is worth 3d a year to you. Send Peter and his handicapped pals 3d for every year you've had it. Now, please, in case it slips your memory. Good idea?

The Chairman,
SCHOOL FOR THE BLIND
(Founded 1838)
SWISS COTTAGE, LONDON, N.W.3